

 This user manual describes all proceedings concerning the Full Electric Injection Molding Machine in detail as much as possible. However, it is impractical to give particular descriptions for all unnecessary or unallowable system operations due to the manual text limit, product specific applications and other causes. Therefore, the proceedings not indicated herein should be considered impractical or unallowable.

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 This User Manual is only suitable for both the specified drive unit main power and drive modules for AE-100 Full Electric Injection Molding Machine. It is better to refer to the material object or touch GSK because some different description may occur along with the alternation of the production.

## PREFACE

Your Excellency,

**It's our pleasure for your patronage and purchase of the AE-100 Full Electric Injection Molding Machine Drive Unit made by GSK CNC Equipment Co., Ltd.**

This user manual is fully described the function and operation methods for the specified drive unit main power and drive module of AE-100 Full Electric Injection Molding Machine; so that the user can entirely understand the integrated drive unit, and use it safely and effectively.

## SECURITY WARNING



Improper operation may generate accident, the person who can operate this product with the corresponding qualification.

In order to guarantee the product safety, normal and effective operation; it is important to read this manual before installing or using product.

It is very essential to note the following marks when you read this user manual.



**Warning** It means that the wrong operation may cause the disaster result —— death or serious injury.



**Caution** It means that the wrong operation may cause hurt the operator, as well damage the equipment.



**Notice** It means that improper use may damage the product and device.

## SAFETY PRECAUTION

### ■ Transportation and storage

- The stack of product cartons should be less than 6 layers.
- Do not climb, stand and place the heavy matters on the cartons.
- Do not use the cable connected with the product to drag or transport the product.
- Do not impact and scratch the panel and the display screen.
- Keep away the damp, sunshine and rain of the cartons.

### ■ Unpacking inspection

- Confirm whether the product is the one you purchased after unpacking.
- Check whether the product is damaged during transporting.
- Confirm the components are completed and without damage based upon the list.
- It is better to contact our company immediately if the inconsistent product type, absent accessory or damage due to transportation.

### ■ Wiring

- The person who attends to the wiring and inspection should be the professional with corresponding ability.
- The product should be reliably grounded, and its grounding resistance should be less than  $0.1\Omega$ ; do not use the neutral conductor (zero line) to instead the grounding cable.
- The wiring should be correct and firm, in order to avoid the product fault or unexpected result occurs.
- The surge absorber diode with the product should be connected with the specified direction; otherwise, the product may be damaged.
- It is necessary to cut off the product power before performing the plug or

open the product case.

### ■Inspection & Repair

- It is important to cut off the power before inspecting.
- Check whether the machine is fault when short-circuit or overloading occurs. Restart can be performed after the fault is eliminated.
- Do not frequently perform the ON/OFF to the product; it is better to wait for 1min. at least when restarting it after the power is turned off.

## SECURITY RESPONSIBILITY

### Security responsibility of the manufacturer

- Manufacturer should take responsibility for the design and structure danger of the drive unit and the accessories which have been eliminated and/or controlled.
- Manufacturer should take responsibility for the security of the drive unit and accessories.
- Manufacturer should take responsibility for the offered information and suggestions for the user.

### Security responsibility of the users

- User should know and understand about the contents of security operations by learning and training the security operations of the motor.
- User should take responsibility for the security and danger because of increasing, changing or modifying the original motor or accessory by themselves.
- User should take responsibility for the danger without following the operations, maintenances, installations and storages described in the manual.

## SAFETY WARNING



### Warning

- The design and manufacture of this product is not used in the machinery and system threatening for personal safety.
- It is necessary to consider the safety protective measure in the design and manufacture when the machinery and system of user selects this product; prevent the unexpected accident from improper operation or abnormal product.

## Confirmation



### Caution

- Never attempt to use the damaged or faulted products.

## Transportation



### Caution

- It is necessary to store and transport based upon the products storage and transportation environment
- Do not pile it up higher, prevent from dropping
- The product should be packed integrally.
- Do not drag the cable, motor axis and encoder transportation servo motor.
- The specified drive unit and servo motor of AE-100 full electric injection molding machine can not undergo the foreign force and impact.

## Installation



### Caution

The specified power module, drive module and servo motor of AE-100 full electric injection molding machine:

- Do not install it on/close the flammable matter to avoid fire.
- Avoid vibration; keep away impacting
- Do not install it when the components are damaged or absent.

**The specified drive unit of the AE-100 full electric injection molding machine:**

- It must be installed inside the defense level  $\geq$ IP43 controllable cabinet.
- Keep adequate space from other equipment.
- It should have good radiating condition.
- To prevent the dust, corrosion gas, conductor, liquid, flammable and explosive matters from entering.

**Servo motor:**

- The installation should be firmed to avoid releasing because the vibration.
- Prevent the motor and encoder is being damaged from liquid invading.
- Never attempt to knock the motor and motor axis, to avoid the damage of encoder.
- Motor axis can not bear the overloading.

## Wiring

 **Warning**

- The person who attends the wiring or inspection should have adequate ability for this job.
- The wiring and inspection should be performed after the power is turned off for 5min.
- The specified drive unit main power, drive module and servo motor of AE-100 full electric injection molding machine should be grounded.
- Incorrect voltage or power polarity may cause explosion or operation accident.
- The wiring of AE-100 full electric injection molding machine can be performed after its power module, drive module and servo motor are installed.
- Ensure that the cable is insulation; avoid pressing the cable, so as not to electric shock.

 **Caution**

- The wiring should be correct and firmed, otherwise, the servo motor may be operated incorrectly, as well, and the device may be damaged due to poor connection.
- Servo motor U, V and W terminals can not be connected reversely and the AC power.
- The servo motor should be connected directly with drive module, which can not

connect with the capacitor, inductor or filter.

- Prevent the conducting fastener and cable head from entering the drive unit.
- The cable and heat-resistance-matter can not close to the radiator and servo motor of the drive unit.
- The fly-wheel diode connected in parallel on the output DC relay can not be connected reversely.

## Debugging operation



### Caution

- Confirm whether the power module, drive module and servo motor is already installed, and firmed before the power is turned on; and check whether its power and wiring are correct.
- The servo motor should be operated without loading before debugging. The loading debugging can be performed after the parameter setting is confirmed. Prevent the machinery and equipment damage from the fault operation.

## Usage



### Caution

- An ESP circuit should be connected to ensure that the equipment can be immediately stopped and the power can be cut off soon when an unexpected accident occurs.
- It is necessary to confirm the operation signal is already turned off before an alarm is reset; otherwise, it may suddenly start again.
- The specified drive unit of AE-100 full electric injection molding machine should be matched with the specified servo motor.
- Do not frequently switch on/off the power module to prevent the system from damaging.
- The specified power module, drive module and servo motor of the AE-100 full electric injection molding machine may be heated after it continues to operate. Never attempt to touch the radiator and motor of the drive unit when operating or after the power is turned off for a while.
- Do not refit the power and drive modules.

## Troubleshooting



### Warning

- The remaining voltage of drive unit still holds for a while even if the power is turned off. Do not disassemble the cable after power off for 5min; as well, do not touch the terminal.
- The person who attends the disassembly and maintenance should have the corresponding professional knowledge.



### Caution

- It is necessary to remove the fault reason when alarm occurs. Perform the restart alarm signal before restarting it.
- Far away from the machine when instantaneous stop occurs and after the power is turned on again, because the machine may suddenly start (The design of the machine should be without hazard when restart).

## Option



### Notice

- The rated torque of servo motor should be higher than the enabled consecutive loading one.
- The moment of inertia value is divided by the motor one, which should be less than the recommended value.
- The specified drive unit of AE-100 full electric injection molding machine should be adapted with the servo motor.

**All specifications and designs are subject to change without notice.**

**This manual is reserved by final user.**

**Sincere thanks for your supporting of GSK's products.**

**Chinese version of all technical documents in Chinese and English languages is regarded as final.**



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## CHAPTER ONE SUMMARY

### 1.1 Product Brief

The Specified Drive Unit of AE-100 Full Electric Injection Molding Machine (it is also called The Specified Drive Unit of AE-100 Full-Digital Full Electric Injection Molding Machine) is a new full-digital drive unit product of GSK, which is used high-performance 32-bit Digital Signal Processor (DSP), Field Programmable Gate Array (FPGA) and MITUBISHI Intelligent Power Module (IPM). It owns the high integration, small size, completed protection, perfect reliability, and it uses the optimal PID calculation and performs the PWM control. Its performance has been reached to the advanced level comparing the similar product with the domestic and overseas.

The specified drive unit main power and its unit of AE-100 full electric injection molding machine should be matched, which is used on the new high-efficient and energy-saving digital full electric injection molding machine of GSK.

It owns more advantages comparing with the traditional control system.

- **Low energy-consumption**

It greatly saves the electric energy and reduces the production cost, which saves 20%~50% comparing with the traditional control method.

- **High control accuracy**

The servo drive system and closed-loop is configured 17-bit absolute encoder, and its repeated accuracy is greatly improved.

- **Excellent consecutive packing and low-velocity performance**

The packing time of servo control system is longer and its pressure is more stable comparing with the traditional one. It is stable with low velocity and its conversion speed is steady.

- **High response velocity**

The response velocity of the servo control system is fast, and the pressure response time is extremely short.

## 1.2 Drive Unit Module Explanation

Description	Explanation
<b>Power module</b> (Also, it is called drive unit power module)	Perform AC-DC conversion function, turn 3-phase AC380V into DC538V offering the DC to drive module. It means DTS02A-POW in AE-100.
<b>Drive module</b> (Also, it is called drive unit drive module)	Perform DC-AC conversion function, turn DC538V into alterable voltage and frequency 3-phase AC outputting to the servo motor. It is the overall of the DTS01A-50, DTS01A-100, DTS02A-200 and DTS02A-450 in AE-100.
<b>Drive unit</b> (Also, it is called motor drive unit or servo drive unit)	It is combined by drive unit power module and drive module; It is the overall of the DTS02A-POW, DTS01A-50, DTS01A-100, DTS02A-200 and DTS02A-450 in AE-100.

## 1.3 Delivered Inspection

1) It is better to inspect immediately based upon the following items after receiving goods.  
If you have any questions, touch the supplier or our company.

Inspection item	Remark
Check the drive unit and servo motor; confirm whether the matched goods are the ordered one.	It is better to confirm based upon the drive unit mark and servo motor nameplate.
Check whether the goods are damaged during transportation.	Check the overall appearance of the goods, and it should be integrated and perfect.
Check whether the cable is released.	Check whether it is loosened by slightly shake.
Check whether the screw is loosened.	Check whether it is loosened by screwdriver.

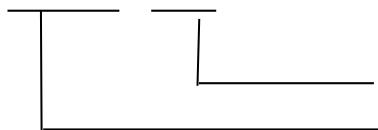
### Notice

- The damaged or absent component of the servo drive unit can not be installed.
- The specified drive unit of AE-100 full electric injection molding machine should be matched with servo motor with its corresponding performance.
- Please touch the supplier or our company, if you have any questions after you received the goods.

## 2) Type meaning:

(1) The specified power module type of AE-100 full electric injection molding machine

**DTS02A- POW**

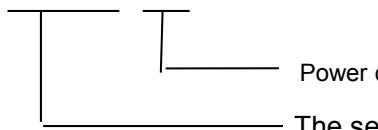


Power module

The series code of servo drive unit

(2) The specified drive module type of AE-100 full electric injection molding machine

**DTS01A- xxx**



Power component nominal current in drive module (For example: DTS02A-450)

The series code of servo drive unit

### (3) Servo motor type

The specified drive unit of AE-100 full electric injection molding machine is the motor drive unit matched with the full electric injection molding machine, which is developed by GSK, as well as the motor. The Chapter Eight offers the data of GSK SJT series servo motor; and other data of the servo motor is supplied with its servo motor.

## 3) Accessories

(1) The standard accessories of AE-100 full electric injection molding machine drive unit

- |                                   |                 |
|-----------------------------------|-----------------|
| ① User Manual (This manual)       | 1 copy          |
| ② CN1 (50-core high density plug) | 4 sets (Note 1) |
| ③ CN2 (26-core high density plug) | 4 sets (Note 2) |

**Note 1:** It is better to adapt with the signal cable (3m) when matching with our control system.

**Note 2:** User can select the feedback cable (3m) when we offer the servo motor.

(2) The basic accessory of servo motor is supplied according to the servo motor user manual

## 1.4 Product Appearance

### 1) The appearance figure of power module

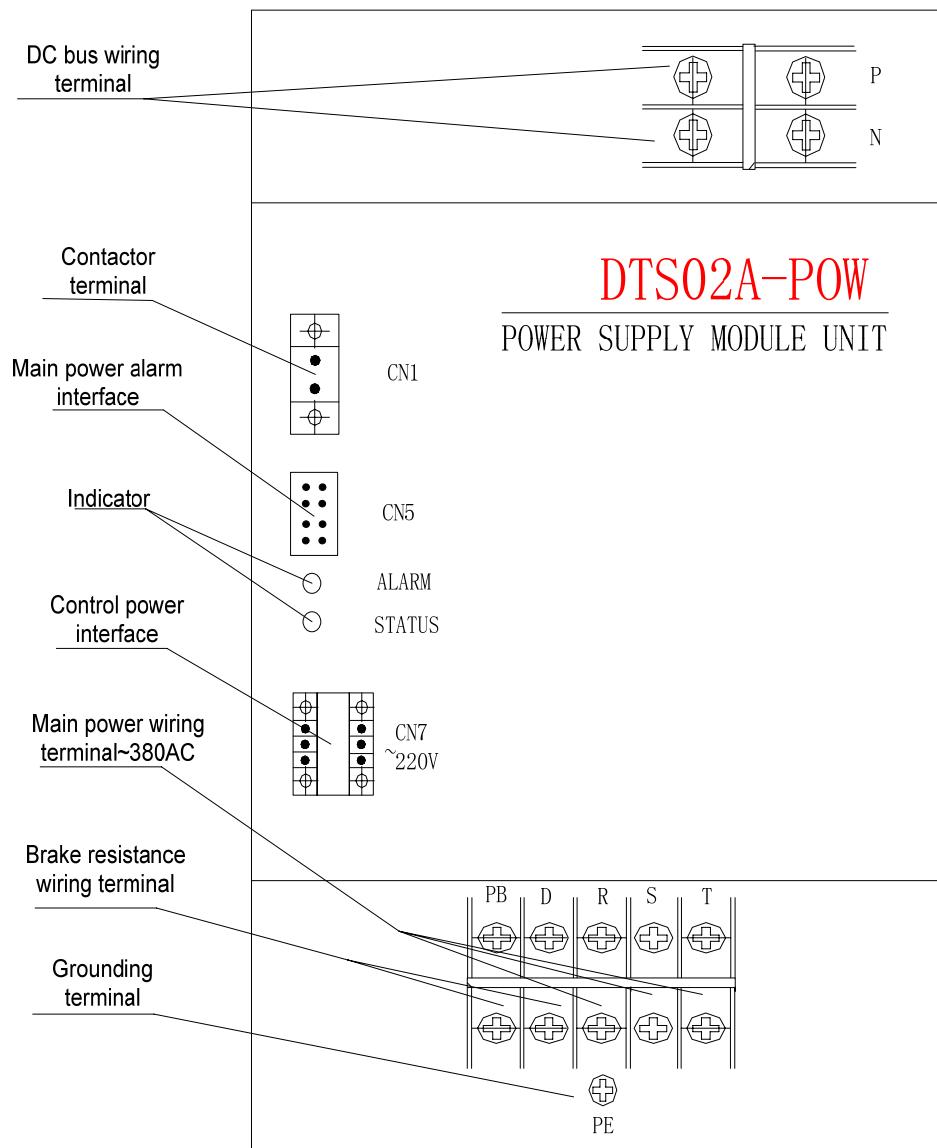


Fig. 1-1 The specified drive unit power module appearance of AE-100 full electric injection molding machine

## 2) Drive module appearance

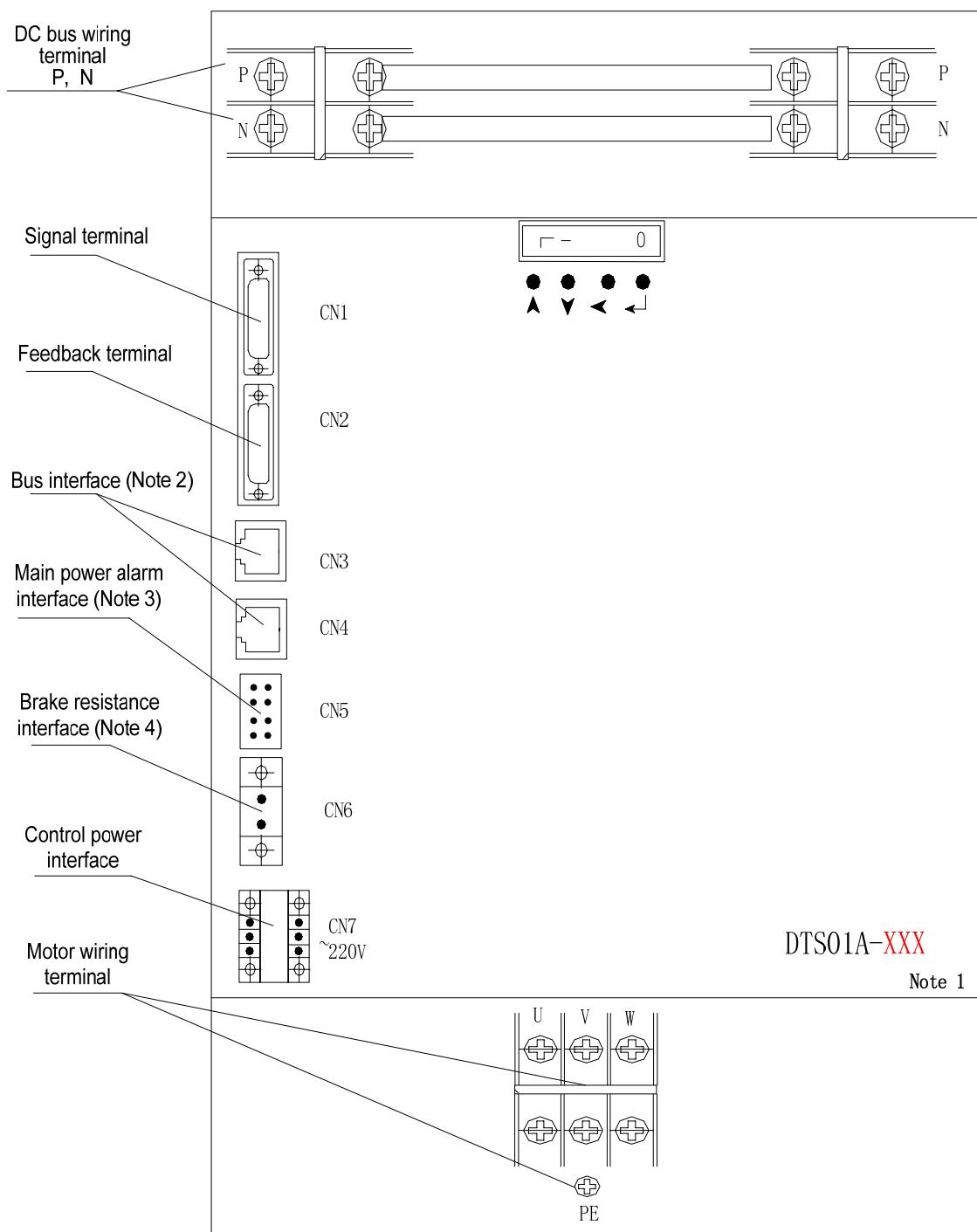


Fig. 1-2 The specified drive unit module appearance of AE-100 full electric injection molding machine

**Note 1:** AE-100 full electric injection molding machine matches 4 drive modules, DTS0XA-XXX means any of the DTS01A-50, DTS01A-100, DTS02A-200 and DTS02A-450. The drive unit configuration may differ from the alterations of the injection molding machines; it is better to refer the machine or touch GSK.

**Note 2:** The bus interface CN3 and CN4 are not used yet, which are reserved for upgrading later.

**Note 3:** The power module alarm interface is connected with the DTS02A-450 drive module CN5, which is reserved in other type drive unit modules.

**Note 4:** The brake resistance interface CN6 in DTS01A-50 is reserved.

### 3) Servo motor appearance

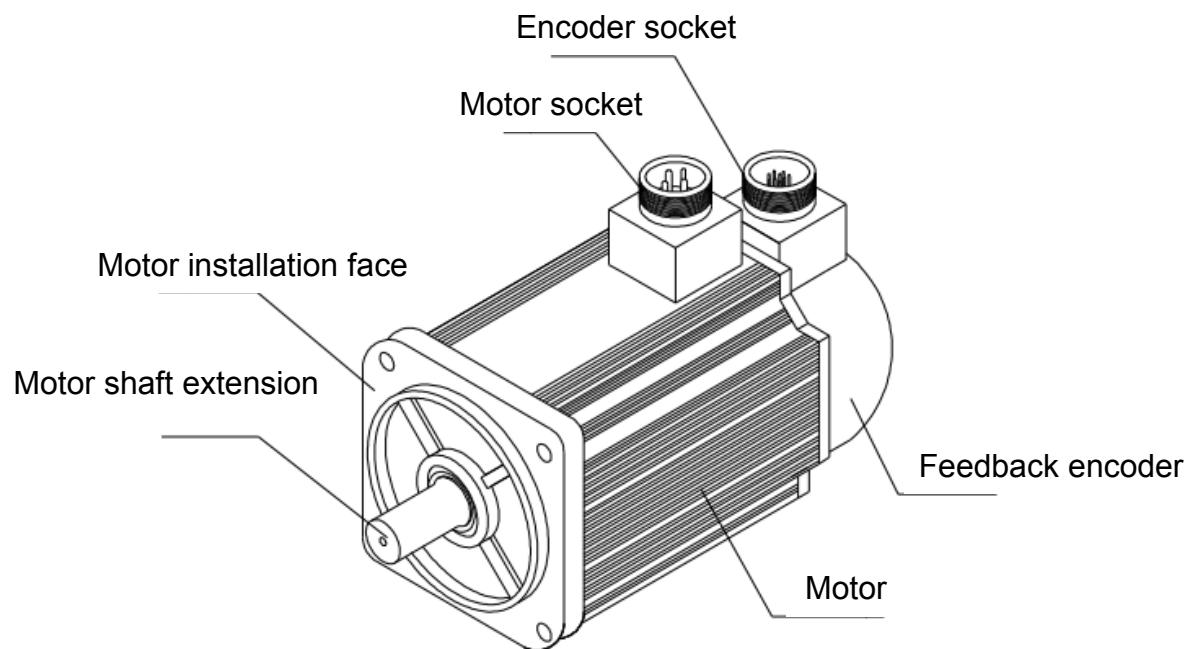


Fig. 1-3 SJT series servo motor appearance

## CHAPTER TWO INSTALLATION

 **Notice**

- The storage and installation of the product should be suitable for the environment condition.
- The pile quantity of the product is restrained, which can not pile too much, to prevent damage and drop from pressing.
- The storage and transportation of the product should be used the original package.
- The damaged or absent component of the product can not be installed.
- The installation of the product should be used the fire-proof material; do not install on the flammable surface or neighbor to avoid the fire hazard.
- The specified drive unit of AE-100 full electric injection molding machine should be installed inside the electric cabinet to prevent the dust, corrosive gas, conducting material, liquid and flammable matter from entering.
- The specified drive unit main power, drive module and servo motor of the AE-100 full electric injection molding machine should be avoided the vibration and impact.
- Never drag the servo motor cable, motor shaft and encoder.

### 2.1 Environment Condition

Item	The specified drive unit of AE-100 full electric injection molding	GSK SJT series servo motor
Usage temperature/Humidity	0°C ~ +55°C (without freeze) Below 95%RH (Without condensation)	-20°C ~ +40°C (without freeze) Below 90%RH (Without condensation)
Storage & transportation temperature/humidity	-40°C ~ +55°C 95%RH (Without condensation)	-40°C ~ +70°C Below 80%RH (Without condensation)
Atmosphere environment	There is no corrosive gas, flammable gas, oil mist or dust etc. inside the controllable cabinet.	There is no corrosive gas, flammable gas, oil mist or dust etc. inside the indoor (without sunshine).
Altitude height	Below altitude 1000m	Below altitude 2000m
Vibration	Less than 0.5G (4.9m/s <sup>2</sup> ), 10 Hz ~ 60Hz (Non-consecutive operation)	
Defense level	It is installed inside the electric cabinet with ≥IP43	IP65

## 2.2 The Appearance Dimension and Installation of Drive Unit

### Notice

- The specified drive unit of AE-100 full electric injection molding machine should be installed inside the electric cabinet with perfect protection
- The specified drive unit of AE-100 full electric injection molding machine should be installed according to the specified direction and interval to guarantee a good radiating condition.
- Never install on/clear the flammable material to avoid fire hazard.

### 1) Installation environment

#### (1) Defense

The structure of the specified drive unit of AE-100 full electric injection molding machine is without defense, and therefore, it should be installed inside the electric cabinet with good protective to avoid touching the corrosive or flammable gas; prevent the conducting material, metal dust, oil mist and liquid from entering it.

#### (2) Temperature, humidity

Environment temperature  $0^{\circ}\text{C} \sim +55^{\circ}\text{C}$ , the consecutive safety working temperature is below the  $45^{\circ}\text{C}$ . In order to guarantee the ambient temperature around the specified drive unit of AE-100 full electric injection molding machine is not consecutively raised, the draft should be blown to the radiator of the drive unit.

#### (3) Vibration and impact

The installation of the specified drive unit of AE-100 full electric injection molding machine can not vibrate; the vibration should be controlled under  $0.5\text{G}$  ( $4.9\text{m/s}^2$ ) with some damping measure. The installation of the drive unit can not undertake the over-pressure and impacting.

### 2) Appearance dimension

The AE-100 full electric injection molding machine produced by GSK is suitable for one power module and 4 drive modules, which separately corresponds to DTS02A-POW, DTS01A-50, DTS01A-100, DTS02A-200 and DTS02A-450. User can adapt the baseplate or panel installation methods, and the installation direction is vertical to the installation face upward (Refer to the Fig. 2-1 The dimension figure of drive unit installation board aperture).

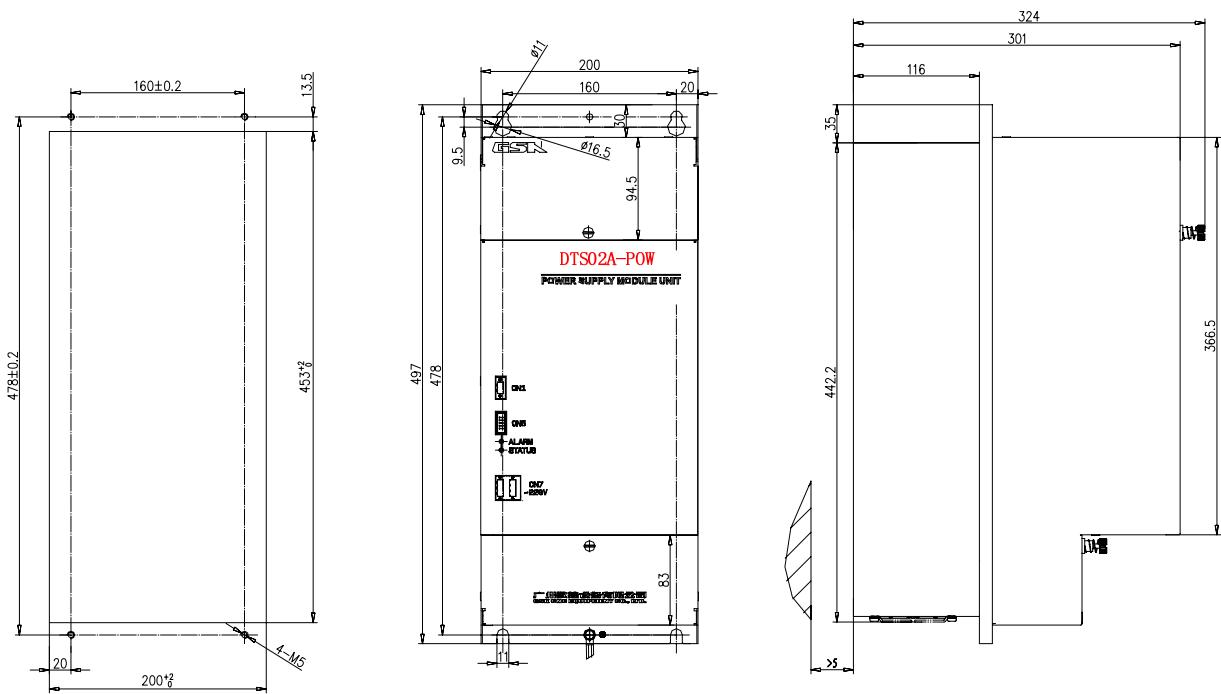


Fig. 2-1 The aperture dimension of DTS02A-POW

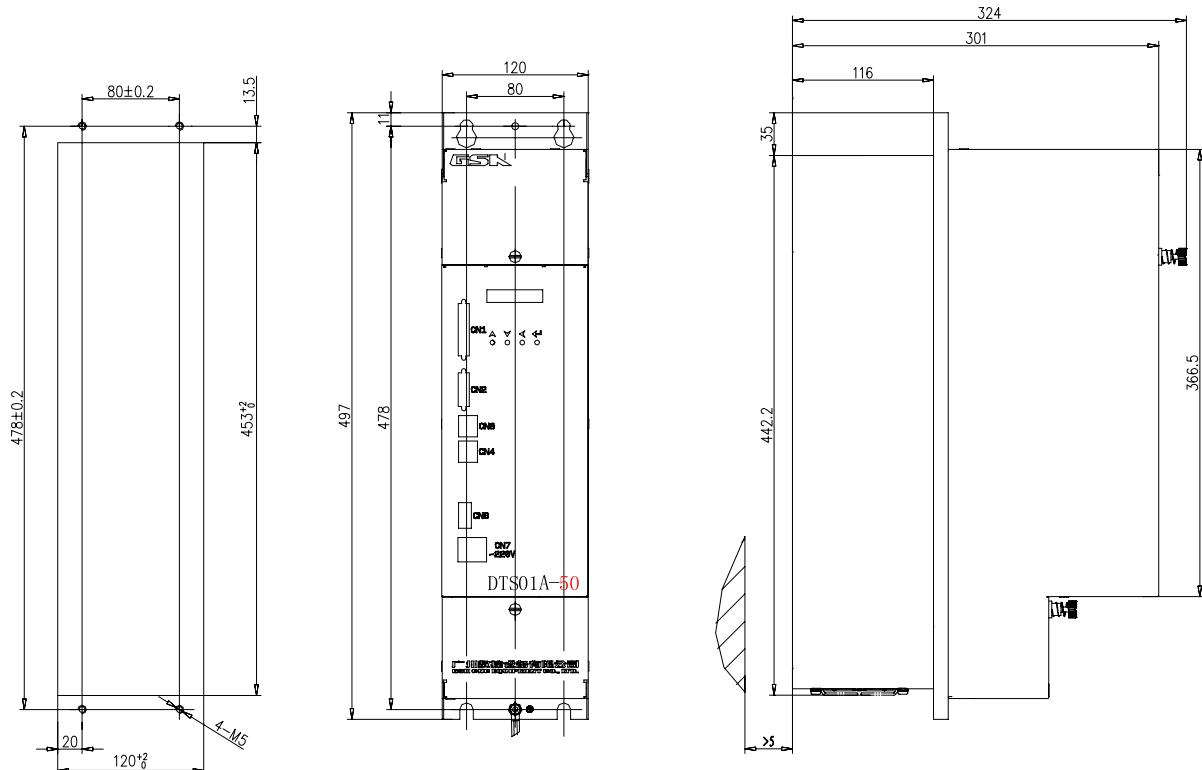


Fig. 2-1(b) The aperture dimension of DTS01A-50

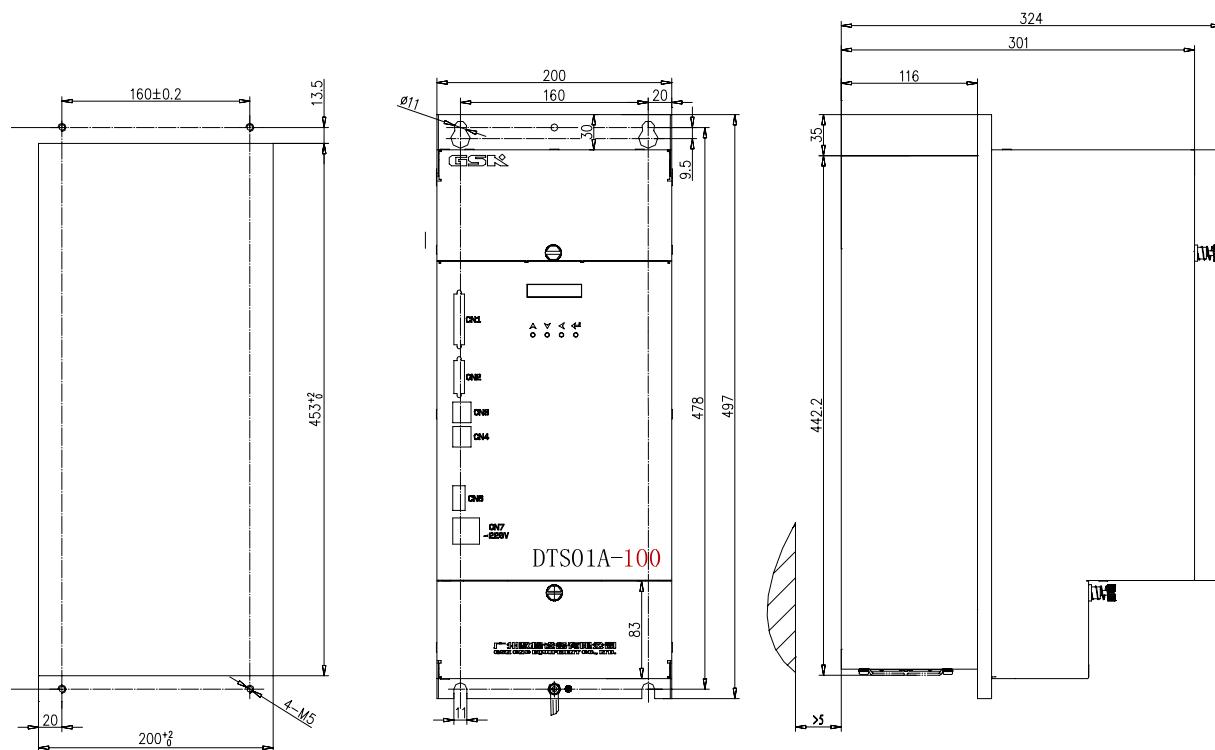


Fig. 2-1(c) The aperture dimension of DTS01A-100

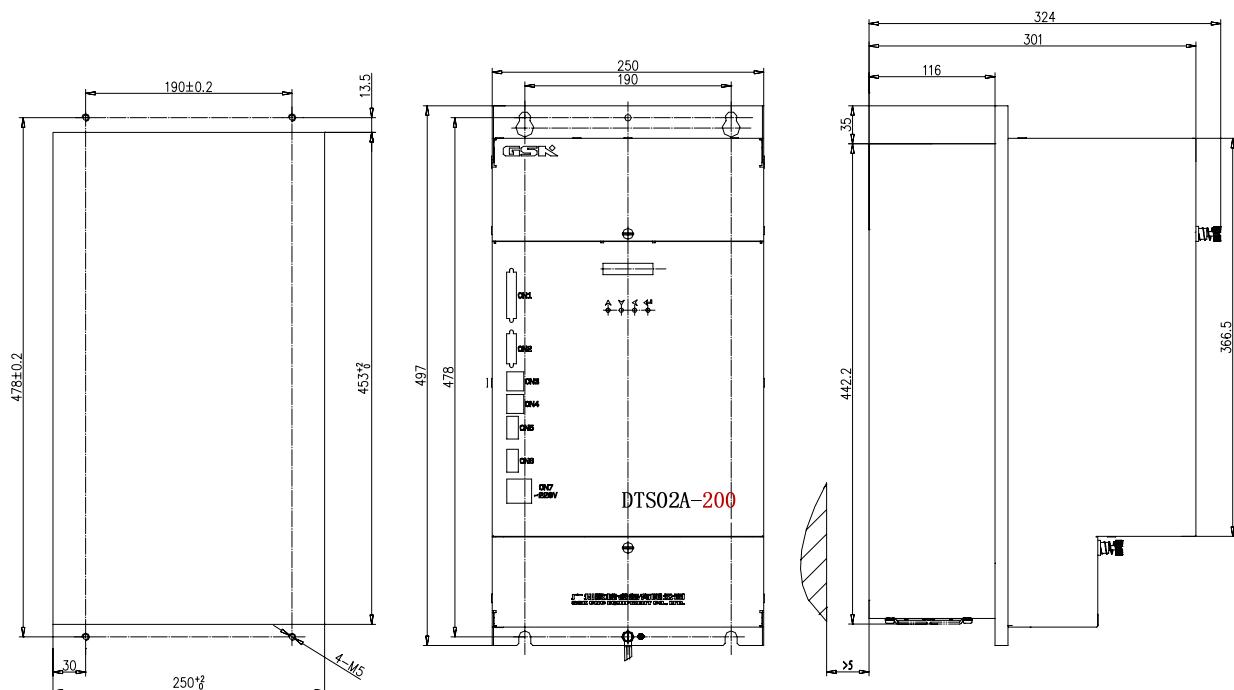


Fig. 2-1(d) The aperture dimension of DTS02A-200

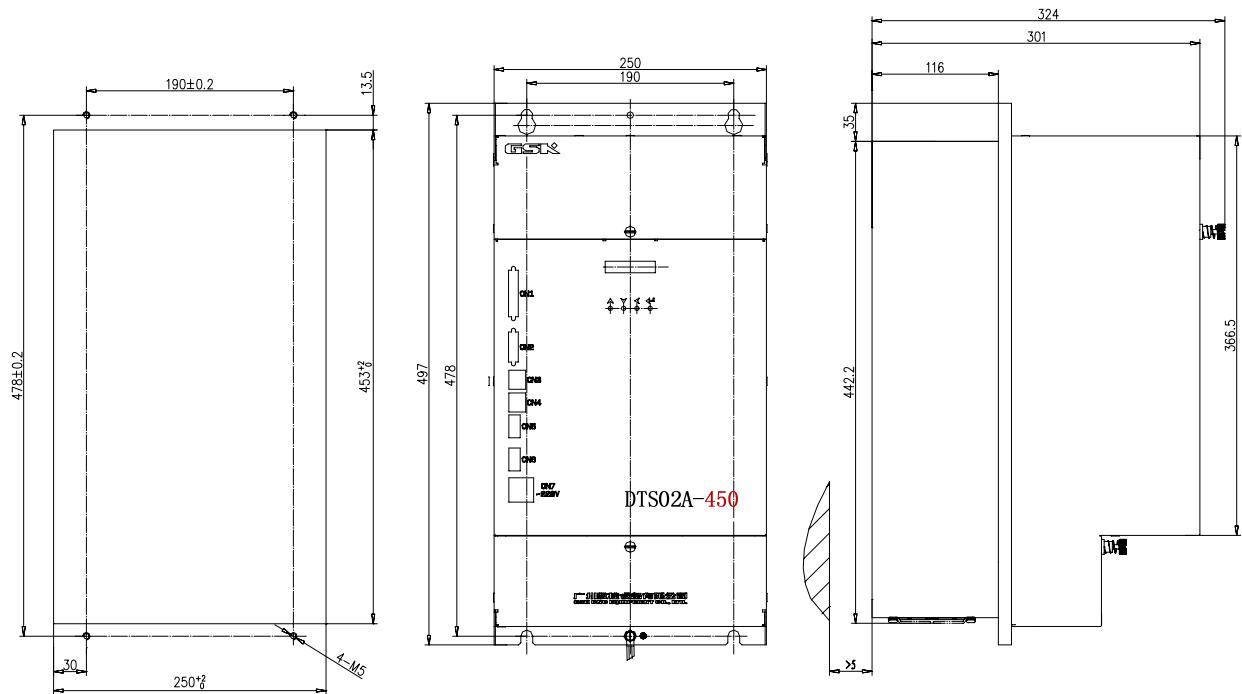


Fig. 2-1(e) The aperture dimension of DTS02A-450

## 2.3 Servo Motor Installation

### Notice

- Never knock the motor shaft or encoder, prevent the motor from vibrating or impacting.
- Do not drag the motor shaft, leading-out cable or encoder when moving the motor.
- The motor shaft can not be undertaken the overloading; otherwise, it the motor may be damaged.
- The motor installation should be firmed with the locking measure.

### 1) Installation environment

#### (1) Defense

The GSK SJT series servo motor is not water-proof, and therefore to prevent the liquid from splashing to the motor, and avoid the oil or water entering the motor from its leading wire and motor shaft.

**Note:** If user needs the water-proof motor, it is better to give an indication to the factory.

#### (2) Temperature, humidity

The ambient temperature holds  $-20^{\circ}\text{C} \sim +40^{\circ}\text{C}$  (without freeze). The motor may heat due to the long-term operation; it is better to radiating the motor if the narrow space or the heat equipment is around it.

The humidity should be less than 90%RH and without condensation.

#### (3) Vibration

The servo motor should be avoided to install at the vibration situation, and the vibration should be less than or equals to 0.5G (4.9m/s<sup>2</sup>).

## 2) Installation method

### (1) Installation method

The SJT series motor uses flange installation method, and motor installation direction is arbitrary.

### (2) Installation notice

- Never knock the motor or motor shaft when disassembling the belt wheel to prevent the encoder from damaging. It is better to disassemble it by the screw-type push/pull tool.
- SJT series motor can not endure a huge axis/radial direction loading. It is recommended to connect the loading with spring coupling.
- The motor should be fixed by check washer to prevent the motor from loosening.

## CHAPTER THREE WIRING

 **Warning**

- The person who attends the wiring or inspection should have adequate ability to deal with this job.
- The wiring and inspection should be performed after the power is turned off for 5min to avoid electric shock.

 **Caution**

- It is necessary to connect based upon the terminal pressure and polarity to avoid equipment damage or personal injury.
- The specified drive unit of the AE-100 full electric injection molding machine and the terminal of the servo motor are grounded firmly.

### 3.1 Power Module Wiring

Fig. 3-1 shows the configuration of DTS02A-POW interface terminal.

- Path: R, S, T, PE, P and N terminal wire diameter  $\geq 16\text{mm}^2$  (Copper wire), PB, D terminal wire diameter  $\geq 4\text{mm}^2$  (Copper wire).

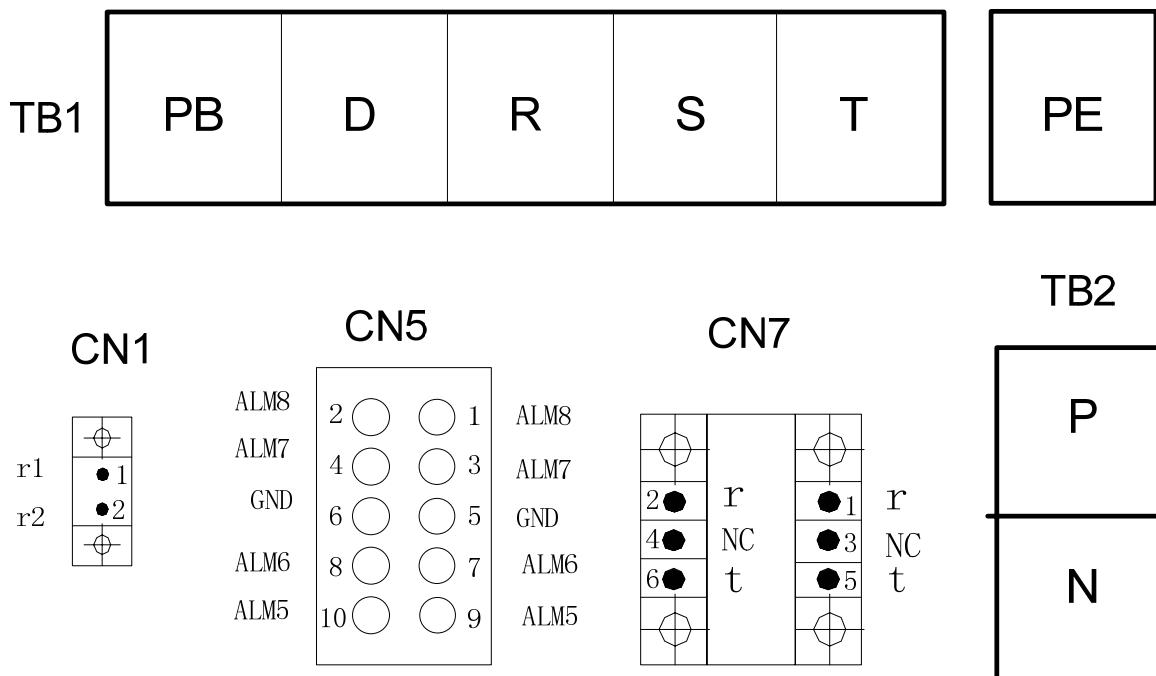


Fig. 3-1 DTS02A-POW electric terminal figure

### 3.2 Power Module Terminal Function

Table 3-1 Terminal function explanation of DTS02A-POW

Terminal No.	Terminal mark	Signal name	Function		
TB1-1	PB	Brake resistance terminal	Brake resistance uses to the dynamic braking. Power module can be normally operated after connecting the external brake resistance; PB and D can not be connected directly.		
TB1-2	D				
TB1-3	R	Main circuit power input terminal	Main circuit power inputs 3-phase AC 380V		
TB1-4	S				
TB1-5	T				
TB1-6	PE	Protective grounding terminal	It is connected with the power grounding and motor one, and its protective grounding resistance should be less than or equals to 0.1Ω.		
TB2-1	P	DC positive terminal	Output DC 538V		
TB2-2	N	DC negative terminal			
CN1-1	r1	Contactor control terminal 1	It is used for controlling the main circuit power input of the power module. The main circuit power is turned off when drive unit fault occurs.		
CN1-2	r2	Contactor control terminal 2			
CN5-1	ALM8	Main circuit open-phase alarm	Alarm signal output		
CN5-2		Main circuit brake alarm			
CN5-3	ALM 7	Main circuit under-voltage alarm	Alarm signal output		
CN5-4		Main circuit over-voltage alarm			
CN5-5	GND	Alarm signal grounding	Alarm signal grounding		
CN5-6		Main circuit under-voltage alarm			
CN5-7	ALM 6	Main circuit over-voltage alarm	Alarm signal output		
CN5-8		Main circuit under-voltage alarm			
CN5-9	ALM 5	Main circuit over-voltage alarm	Alarm signal output		
CN5-10		Main circuit under-voltage alarm			
CN7-1	r	Single-phase control power	The control circuit power input/output terminal AC 220V 50Hz is connected with the r, t of the drive module CN7.		
CN7-2					
CN7-5	t				
CN7-6					
CN7-3	NC		Without connecting the reservation		
CN7-4					

### 3.3 The Wiring of Drive Module

#### 1) The external wiring figure of drive module

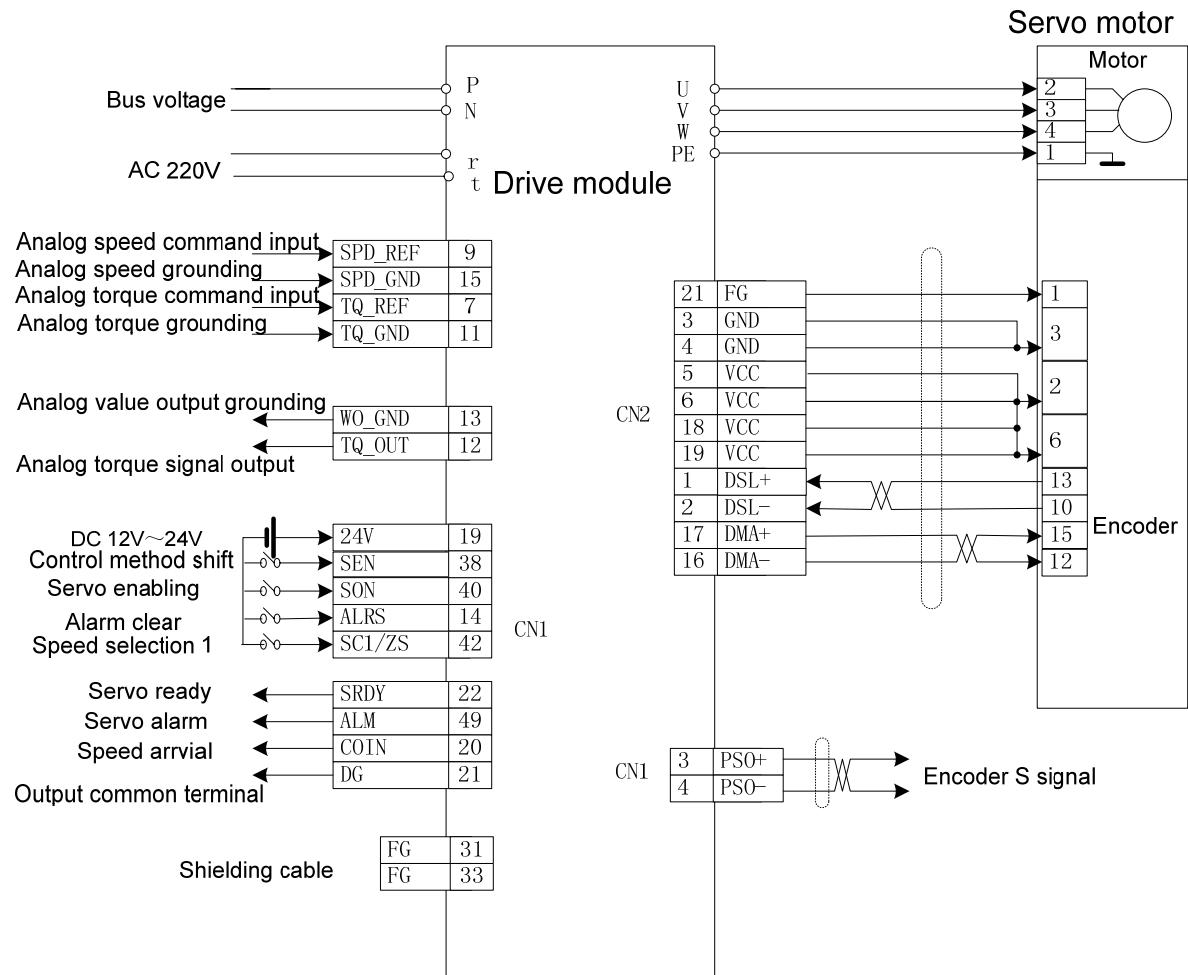


Fig. 3-2 The external wiring of drive module

#### 2) Drive module interface explanation

##### (1) The power terminal TB3, TB4 in drive module

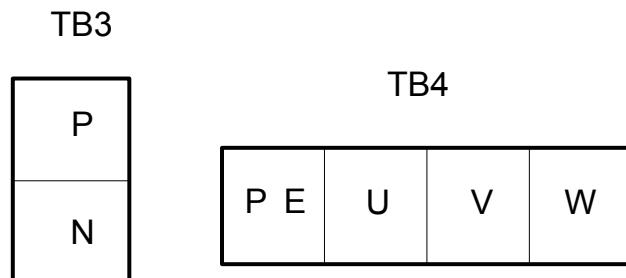


Fig. 3-3 The power terminal in drive unit

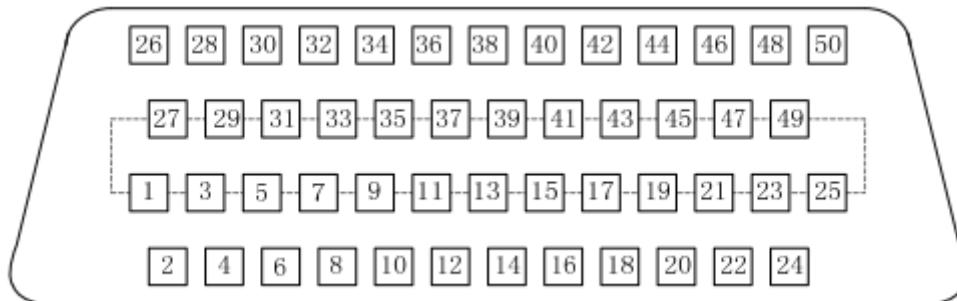
Table 3-2 The external leading-wire diameter on each drive module in AE-100

Terminal name	DTS02A-450	DTS02A-200	DTS01A-100	DTS01A-50
P, N (mm <sup>2</sup> )		16		
U, V, W, PE (mm <sup>2</sup> )	16	4	2.5	1.5
r, t (mm <sup>2</sup> )		1		

Note: The abovementioned leading-wire is used the copper wire.

## (2) Control signal CN1

CN1 is 50-core high density plug, and its pin definition is shown below:



2	NC		1	NC		26	NC	
4	PSO-	Absolute encoder S-phase	3	PSO+	Absolute encoder S+phase	27	NC	
6	NC		5	NC		29	NC	
8	NC		7	TQ_REF	Analog torque command input	31	FG	Shielding grounding cable terminal
10	NC		9	SPD_REF	Analog speed signal input	33	FG	Shielding grounding cable terminal
12	TQ_OUT	Analog torque signal output	11	TQ_GND	Analog torque grounding	35	NC	
14	ALRS	Alarm clear	13	WO_GND	Analog value output grounding	37	NC	
16	NC		15	SPD_GND	Analog speed grounding	39	NC	
18	NC		17	NC		41	NC	
20	SCMP	Speed arrival output	19	COM+	Input terminal power +	43	NC	
22	SRDY	Servo ready output	21	DG	Output terminal common port	45	NC	
24	NC		23	NC		47	NC	
			25	NC		49	ALM	Servo alarm output
						50	NC	

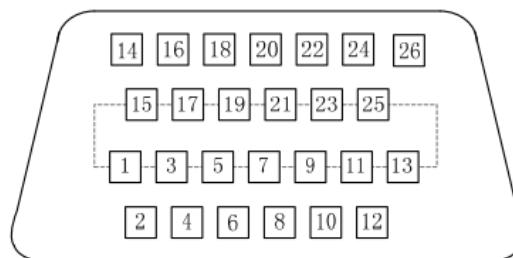
Fig. 3-4 CN1 pin

- Wire diameter: It adopts the shielding cable (It is better to use the twisted shielding cable); its wire diameter  $\geq 0.12\text{mm}^2$ , and the shielding layer should be connected with FG terminal.

- Wire length: The cable should be shortened as much as possible, and the control CN1 cable should be less than 3m.
- Wiring: It is better to depart from the dynamic wire to prevent the interference from entering.
- Install the surge absorber component of the sensitive parts (coils) in the corresponding circuit: DC coil reverse parallel fly-wheel diode, AC coil parallel resistance-capacitance absorption circuit

### (3) Encoder feedback signal terminal CN2

The encoder feedback signal terminal CN2 is 26-core high density plug, which is matched with the 17bit absolute encoder; and its pin distribution is shown below:



2	DSL-	Encoder DSL-input	1	DSL+	Encoder DSL+input	14	NC	
3	GND	Power output grounding	15	NC		16	DMA-	Encoder DMA-output
4	GND	Power output grounding	17	DMA+	Encoder DMA+output	18	VCC	Power output
5	VCC	Power output	19	VCC	Power output	20	NC	
6	VCC	Power output	21	FG	Shielding grounding cable terminal	22	NC	
7	NC		23	NC		24	NC	
8	NC		25	NC		26	NC	
10	NC							
12	NC							
13	NC							

Fig. 3-5 CN2 pin

- Wire diameter: It adopts the shielding cable (It is better to use the twisted shielding cable); its wire diameter  $\geq 0.12\text{mm}^2$ , and the shielding layer should be connected with FG terminal.
- Wire length: The cable should be shortened as much as possible, and the control CN2 cable should be less than 20m.
- Wiring: It is better to depart from the dynamic wire to prevent the interference from entering.

### (4) Other terminal figures

Wherein, the bus interface CN3 and CN4 are reserved.

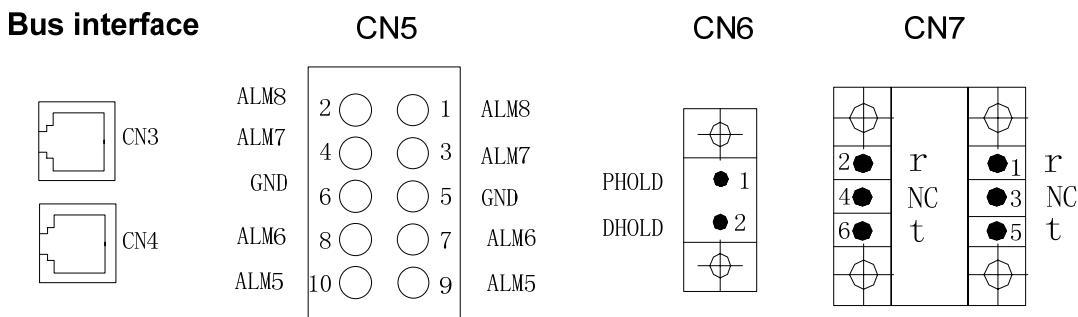


Fig. 3-6 Other terminals

**Notice**

- U, V and W should be connected with the motor winding one by one, which can not be performed reversely.
- The cable and leading-wire should be fixed and can not close to the specified drive unit radiator and motor of AE-100 full electric injection molding machine, in order to avoid reducing the insulation performance due to the heat.
- There is a high-capacity electrolytic capacitor inside the specified drive unit of AE-100 full electric injection molding machine; the remaining voltage will still hold even if the power is turned off. Do not touch the specified drive unit and motor of AE-100 full electric injection molding machine after the power is turned off for 5min.

### 3.4 Drive Module Terminal Function

#### 1) Power terminal

Table 3-3 The function explanations of drive module terminal

Terminal No.	Terminal mark	Signal name	Function
TB3-1	P	DC bus positive terminal	Main circuit DC power input terminal is connected with P, N of TB2 of the power module unit.
TB3-2	N	DC bus negative terminal	
TB4-1	PE	Protective grounding terminal	Protective grounding terminal; the protective grounding resistance should be less than 0.1Ω, servo motor output and power input common
TB4-2	U	3-phase AC output terminal	It should be connected with the motor U, V and W terminal one by one.
TB4-3	V		
TB4-4	W		
CN5-1	ALM 8	Main circuit open-phase alarm	Alarm signal input
CN5-2			
CN5-3	ALM 7	Main circuit brake alarm	Alarm signal input
CN5-4			
CN5-5	GND	Alarm signal grounding	Alarm signal grounding
CN5-6			
CN5-7	ALM 6	Main circuit under-voltage	Alarm signal input

CN5-8		alarm			
CN5-9	ALM 5	Main circuit over-voltage alarm	Alarm signal input ※1		
CN5-10					
CN6-1	PHOLD	Electric brake	Electric brake relay contactor output terminal, the relay actuates when the drive unit fault occurs or it stops, external connection is performed between brake resistance and motor ※2		
CN6-2	DHOLD				
CN7-1	r	Control power single phase input terminal	The control circuit power input/output terminal AC 220V 50Hz is connected with the r, t of CN7 of the power module unit.		
CN7-2					
CN7-5	t				
CN7-6					
CN7-3	NC		Without connection		
CN7-3					

※1: Only the injection drive unit is with CN5 interface in the drive unit and others are reserved.

※2: Different drive module types match with different brake resistance. Refer to the following table (Wherein, there is no brake resistance of DTS01A-50).

Table 3-4 The brake resistance specification of each drive module in AE-100

Drive module type	Brake resistance parameter	Resistance value (Ohm)	Power (W)
DTS01A-100		1 × 3	450
DTS02A-200		1 × 3	450
DTS02A-450		1 × 3	600 × 3

## 2) Control terminal CN1

Table 3-5 Control signal input/output terminal CN1

No.	Signal name	Mark	I/O	Method	Function
CN1-9	Analog velocity command input	SPD_REF	Type3		Analog velocity command input terminal, its input voltage range is -10V ~ +10V; the corresponding rotation range can be determined by the parameter No.42. For example: If the parameter No.42 is set to 3000, the top analog velocity command voltage corresponds to the rotation speed (R/MIN, -3000r/min ~ 3000r/min). It may be limited as top speed if it exceeds the maximum speed.
CN1-15	Analog velocity grounding	SPD_GND			Analog velocity grounding

CN1-7	Analog torque command input	TQ_REF	Type3	Analog velocity command input terminal, its input voltage range is -10V ~ +10V; the corresponding torque range can be determined by the parameter No.44. $30 \times 50 / 100 = 15\text{N}\cdot\text{m}$ For example: it indicates with the percentage of the rated torque. If the rated torque is 30N·m and the setting value is 50, and then the torque of the maximum analog torque command is $30 \times 50 / 100 = 15\text{N}\cdot\text{m}$ .
CN1-11	Analog torque grounding	TQ_GND		Analog torque grounding
CN1-13	Analog value output grounding	WO_GND		Analog value output grounding
CN1-12	Analog torque signal output	TQ_OUT	Type4	The analog torque signal output voltage range is -10V ~ +10V, which is determined the torque range by the parameter No.44. For example: it indicates with the percentage of the rated torque. If the rated torque is 30N·m and the setting value is 50, and then the analog torque output range is -10V ~ +10V and its corresponding torque is -15N·m~15N·m.
CN1-38	Control method shift terminal	SEN	Type1	Shift the input terminal with servo control method; the shift method can be determined by the parameter No.10. Control method shift selection: [0] Do not shift [1] Shift to the analog torque control mode in analog speed control method when SEN closes. [2] Shift to analog (Speed + torque) control mode in the analog speed control method when SEN closes. [3] Shift to analog speed control mode in the analog torque control method when SEN closes. [4] Shift to analog (speed + torque) control mode in analog torque control method when SEN closes.
CN1-40	Servo enabling	SON	Type1	Servo enabling input terminal [1] SON ON: the specified drive unit of AE-100 full electric injection molding machine operates. [2] SON OFF: the specified drive unit of AE-100 full electric injection molding machine stops; the motor is on the free state after stopping operation. <b>Note 1:</b> The motor should be still when the SON OFF is opened before the SON ON. <b>Note 2:</b> The command can be input waiting for at least 50ms after opening to SON ON.
CN1-14	Alarm clear	ALRS	Type1	Alarm clear input terminal [1] ALRS ON: system alarm clears. [2] ALRS OFF: system alarm holds.

CN1-42	Speed selection 1 Zero speed clamping	SC1/ZS	Type1	S	Velocity selection 1 input terminal In the velocity control method, the combination of SC1 and SC2 is used (at present, the SC1 and SC2 are OFF) to select different internal speed [1] SC1 OFF, SC2 OFF: internal speed 1 [2] SC1 ON, SC2 OFF: internal speed 2 [3] SC1 OFF, SC2 ON: internal speed 3 [4] SC1 ON, SC2 ON: internal speed 4 <b>Note:</b> The numerical value of the internal speed 1~4 can be modified by parameter. Zero speed clamping enables in analog value control. The motor rotation speed is forcedly set to 0 when zero speed clamping enables.
CN1-22	Servo ready output	SRDY	Type2		Servo ready output terminal [1] SRDY ON: Control power and power module are normal. There is no alarm for the specified drive unit of AE-100 full electric injection molding machine; servo ready output ON. [2] SRDY OFF: The power module opens or the DTS01A injection molding machine unit alarms; servo ready output OFF.
CN1-49	Servo alarm output	ALM	Type2		[1] ALM ON: There is no alarm for the specified drive unit of AE-100 full electric injection molding machine; servo alarm output ON. [2] ALM OFF: There is an alarm for the specified drive unit of AE-100 full electric injection molding machine; servo alarm output OFF.
CN1-20	Speed arrival output	SCMP	Type2	S	Speed arrival output terminal The speed arrival outputs ON when the speed arrives or exceeds the setting one.
CN1-21	The common terminal of the output one	DG			The grounding common terminal of control signal output terminal (other than the CZ)
CN-31	Shielding grounding wire	FG			Shielding grounding cable terminal
CN-32					
CN1-3	S signal output of absolute encoder	PS+			Absolute encoder S signal output
CN1-4		PS-			

**Note:** I/O type explanation: 1) Type1: Switch value input; 2) Type2: Switch value output; 3) Type 3: Analog value input;  
4) Analog value output Type 5: Absolute encoder interface. Refer to “3.5 Interface circuit diagram”.

### 3) Feedback signal terminal CN2

Table 3-6 Encoder signal input/output terminal CN2

Terminal No.	Signal name	Terminal mark		Function
		Mark	I/O	
CN2-5	Power output +	VCC		Servo motor photoelectricity encoder uses +5V power; Use the multi-core cable to parallel when cable is longer.
CN2-6				
CN2-18	Power output -	GND		
CN2-19				
CN2-3	Encoder DSL + input	DSL+	Type5	Encoder differential data signal
CN2-4				
CN2-1	Encoder DMA + input	DMA+	Type5	Encoder differential clock signal
CN2-2	Encoder DMA - input	DMA-		
CN2-17	Encoder DMA + input	DMA+		
CN2-16				

### 4) Bus terminal CN3 and CN4

Table 3-7 bus terminals

Terminal No.	Signal name	Function
CN3	RJ-45 Standard interface	It is connected with control system or other units.
CN4	RJ-45 Standard interface	It is connected with control system or other units.

## 3.5 I/O Interface Circuit

### 1) Switch value input interface

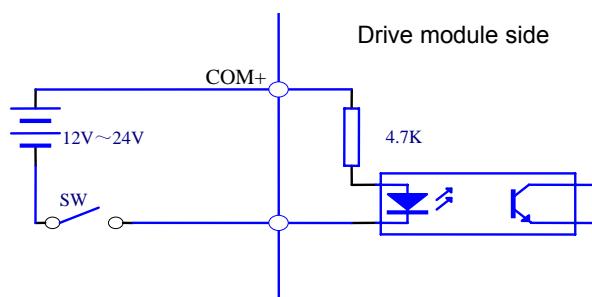


Fig. 3-7 Type1 switch value input interface

- (1) It is supplied by user, DC 12 V~DC 24V, current  $\geq 100\text{mA}$ ;
- (2) **Notice:** The specified drive unit of AE-100 full electric injection molding machine can not be operated if the current polarity connection is reversed.

## 2) Switch value output interface

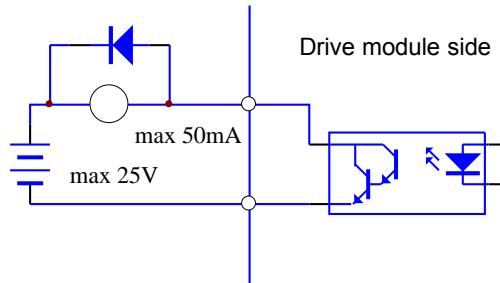


Fig. 3-8 Type2 switch value output interface

- (1) The external power is offered by user. It is essential to note that the specified drive unit of AE-100 full electric injection molding machine may be damaged if its power polarity is reversed.
- (2) The output is open-collector type, and its maximum current is 50mA; the top voltage of external power is 25V. And therefore, the loading of switch value output signal should be met this limit requirement. The specified drive unit of AE-100 full electric molding machine may be damaged if it exceeds the limit requirement or the output is directly connected with the power.
- (3) The anti-parallel fly-wheel diode should be placed at both ports of the loading if the loading is the relay sensitive one. If the fly-wheel diode is reversed, the specified drive unit of the AE-100 full electric injection molding machine may be damaged.

## 3) Absolute encoder interface

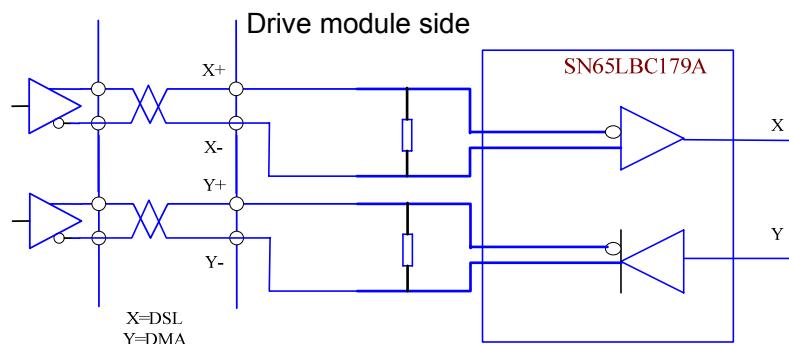


Fig. 3-9 Absolute photoelectric encoder input interface

## 4) Analog value input circuit

The analog input signal is speed command or torque command input signal.

The voltage range of input signal X\_REF is -10V~10V.

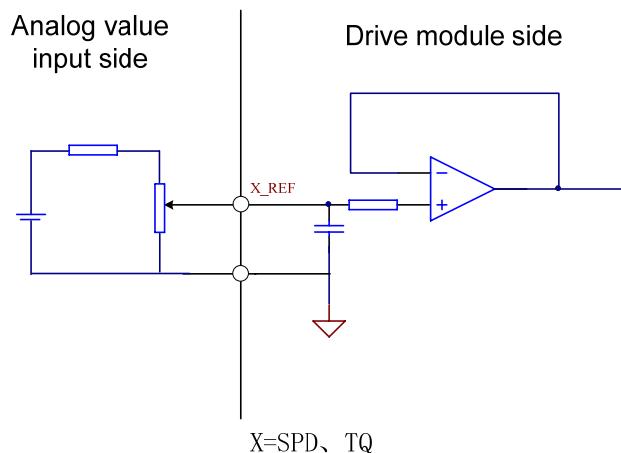


Fig. 3-10 Analog value input circuit

### 5) Analog value output circuit

Analog output signal is speed or torque output signal.

The voltage range of output signal  $X_{REF}$  is  $-10V \sim 10V$ .

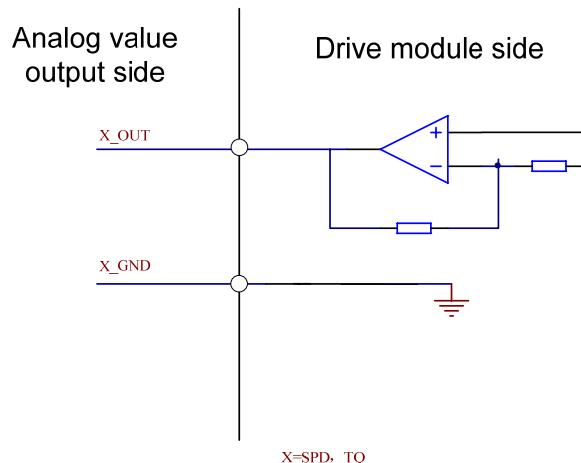


Fig. 3-11 Analog value output circuit

### 3.6 The Integrated Connection Diagram of Drive Unit

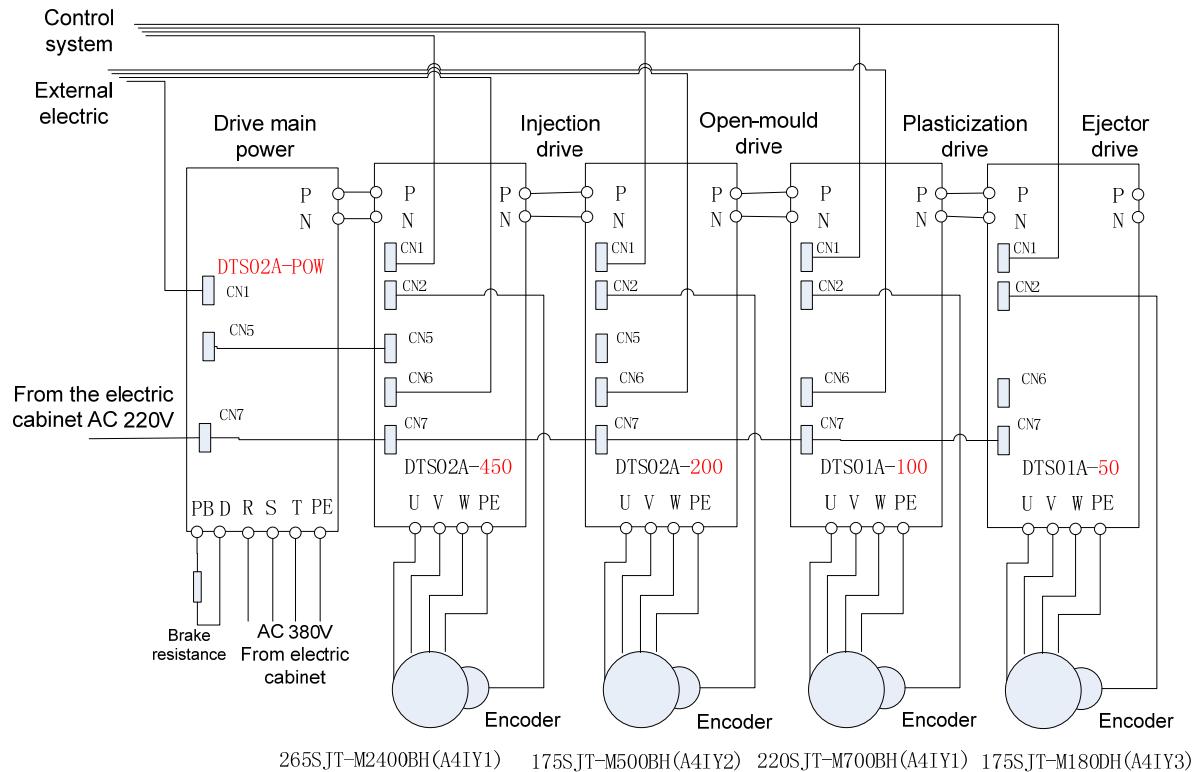


Fig. 3-12 Drive unit integrated connection diagram

As the abovementioned figure shows:

- 1) The CN1 in the drive module is connected with the system, which is used for information exchange;
- 2) The CN1 in the power module and the CN2 in the drive module is connected with the external electric, which is separately controlled the AC380 input of power module and the UVW input of each motor;
- 3) The AC220V of the CN7 interface in power module and the AC380V on TB1 inside the electric cabinet are separated from the electric wire-mesh; Contact GSK for details.



## CHAPTER FOUR PARAMETER

 **Notice**

- The person who adjusts the parameter should be understood the parameter meaning; incorrect setting may cause the equipment damage and personal damage.
- It is recommended that the parameter debugging should be performed in case of the servo motor is without loading.
- The motor parameter adapts the GSK SJT series by default. The motor may not normally operate if uses other servo motors.

### 4.1 Parameter List

The following parameters only are suitable for the specified configuration drive module and servo motor of AE-100 full electric injection molding machine; and the parameter may different if other drive units or servo motor are used. It is better to refer to the material or contact the GSK.

Table 4-1 The standard configuration drive module and servo motor in AE-100

Drive module type	DTS02A-450	DTS01A-200	DTS02A-100	DTS01A-50
Servo motor type	265SJT-M2400B H (A4IY1)	175SJT-M500BH (A4IY2)	220SJT-M700BH (A4IY1)	175SJT-M180DH (A4IY3)
Purpose	Injection motor drive	Mould opening motor drive	Plasticization motor drive	Ejector motor drive

The following parameters are the corresponding PA parameter for the above-mentioned standard motor and drive module.

Table 4-2 The default PA parameter list of AE-100 drive module

Parameter Series No.	Parameter name	DTS02A-450	DTS02A-200	DTS01A-100	DTS01A-50
0	Password	412	412	412	412
1	Type code	23	21	22	20
2	Software edition (Read)	104	104	104	104
3	Initial display state	0	0	0	0
4	Control method selection	1	1	1	1
5	Velocity proportional gain	100	50	50	60
6	Velocity integral time constant	30	100	100	90
7	Torque command filter	300	250	250	100
8	Velocity inspection low-pass filter	300	253	253	300
9	Reserved				
10	Control method shift selection	0	0	0	0
11	Reserved				
12	Reserved				

13	Reserved				
14	Reserved				
15	Reserved				
16	Reserved				
17	Reserved				
18	Analog velocity low-pass filter	800	800	800	800
19	Analog torque low-pass filter	800	100	100	800
20	Drive prohibition input disabled	1	1	1	1
21	JOG operation velocity	120	120	120	120
22	Reserved				
23	Top velocity limit	2400	2400	2400	3600
24	Internal velocity 1	0	0	0	0
25	Internal velocity 1	100	100	100	100
26	Internal velocity 1	300	300	300	300
27	Internal velocity 1	-100	-100	-100	-100
28	Reserved				
29	Positive/negative torque limit	1	1	1	1
30	Reserved				
31	Reserved				
32	Reserved				
33	The slavery machine number of industry Ethernet	0	0	0	0
34	Internal CCW torque limit	300	300	300	300
35	Internal CW torque limit	-300	-300	-300	-300
36	External CCW torque limit	300	300	300	300
37	External CW torque limit	-300	-300	-300	-300
38	Velocity dry run, JOG run torque limit	300	300	300	300
39	Speed command reverse	0	0	0	0
40	Reserved				
41	Analog speed command zero modification value	0	0	0	0
42	The rotation speed of maximum analog speed command voltage	1550	1500	1500	2500
43	Analog torque command zero modification value	0	0	0	0
44	The torque of maximum analog torque command	300	300	300	300
45	The top speed controlled by torque	1550	1500	1500	2500

# CHAPTER FIVE ALARM AND TROUBLESHOOTING

 **Notice**

- The person who inspects the machine should have the professional knowledge and ability.
- The specified drive unit and motor of AE-100 full injection molding machine can be touched after its power is turned off for 5min to prevent the electric shock and burn.
- The specified drive unit of AE-100 full electric injection molding machine can be used after the fault removes according to the alarm code.
- Confirm that the SON (Servo enabled) signal is disabled before resetting alarm to prevent the unexpected accident from suddenly starting.

## 5.1 Alarm List

Table 5-1 Alarm list

Alarm code	Alarm name	Content
--	Normal	
1	Overspeed	Servo motor speed exceeds setting value
2	Main circuit overvoltage	Main circuit power voltage excessive high
3	Main circuit undervoltage	Main circuit power voltage excessive low
4	Reserved	
5	Motor overheating	Motor temperature excessive high
6	Speed amplifier saturation fault	Speed regulator saturation for long time
7	Drive prohibition abnormal	CCW, CW drive prohibition input OFF
8	Reserved	
9	Encoder fault	Encoder signal error
10	Control power undervoltage	Control power $\pm 15V$ lower
11	IPM module fault	IPM intelligent module fault
12	Overcurrent	Motor current excessive high
13	Overloading	The specified drive unit of AE -100 full electric injection molding machine and the motor overloading (instantaneous overheating)
14	Open-phase	3-phase AC power open-phase
15	Encoder counting error	Encoder counting abnormal
16	Motor overheating overloading	The electrothermal value of the motor exceeds setting value ( $I^2t$ inspection)
17	Speed response fault	Speed response error excessive big
18	FPGA fault	FPGA version inspection error
19	Heat resetting	System is being heat resetting
20	EEPROM error	EEPROM error
21	Brake fault	Brake circuit fault
22	Encoder read error	Fail to read encoder of drive module
23	A/D core error	A/D convertor error
24	Encoder type error	Inconsistent encoder type
25	Reserved	
26	Reserved	

27	Reserved	
28	Reserved	
29	Reserved	
30	Reserved	
31	Encoder write error	Fail to write encoder of drive module

## 5.2 Alarm Troubleshooting Method

Table 5-2 Troubleshooting method

Alarm code	Alarm name	Operation state	Reason	Troubleshooting
1	Overspeed	It occurs when switching on the control power	①Control circuit board fault ②Encoder fault	①Change the drive module ②Change the servo motor
		It occurs in the motor operation	Command pulse input frequency excessive high	Correctly set the command pulse input
			Acceleration/deceleration time constant excessive small, so that the speed overshoot value is excessive big.	Increase acceleration/deceleration time constant
			Encoder fault	Change the servo motor
			Encoder cable defective	Change the encoder cable
			Instable servo system causing overshoot	①Set the system related gain again. ②Reduce the loading inertia moment ratio if the gain can not set to an available value.
			Loading inertia excessive big	①Reduce loading inertia ②change a bigger power drive unit and motor
		It occurs when the motor is performed at the beginning.	Encoder zero error	①Change servo motor ②Change encoder cable. The manufacturer should adjust the encoder zero.
			①Incorrect connection of U, V and W leading wire ②Incorrect connection of encoder cable leading wire	Correct wiring
			Circuit board fault	Change drive module
2	overvoltage Main circuit	It occurs when switching on the control power	①Power voltage excessive high ②Abnormal voltage waveform	Check the power supply
		It occurs when power module ON	Disconnect of the brake resistor	Wiring again
		It occurs in the	①Brake transistor damage	Change the power module

		motor operation	②Internal brake resistor damage	
			Brake circuit capacity inadequate	①Reduce on-off frequency ②Increase acceleration/deceleration time constant ③Reduce torque limit value ④Reduce loading inertia ⑤Change a bigger power drive module and motor
3	Main circuit undervoltage	It occurs when power module ON	①Circuit board fault ②Power insurance damage ③Soft-start circuit fault ④Rectifier damage	Power module
			①Power voltage low ②Temporarily cut off for more than 20ms	Check the power
		It occurs in the motor operation	①Power capacity inadequate ②Instantaneously cut off	Check the power
			Radiator overheat	Check the loading
4	Reserved			
5	Motor overheating	It occurs when switching on the control power	Circuit fault	Change the drive module
			①Cable broken ②Relay damaged of the motor internal temperature	①Check the cable ②Check the motor
		It occurs in the motor operation	Motor overloading	①Reduce loading ②Reduce on-off frequency ③Reduce torque limit value ④Reduce the related gain ⑤Change a bigger power drive module and motor
			Internal motor fault	Change the servo motor
6	saturation fault Speed amplifier	It occurs in the motor operation	Motor chuck by machinery	Check the loading machinery part
			Loading excessive big	①Reduce loading ②Change a bigger power drive module and motor
7	abnormal prohibition Drive		Input terminals OFF of CCW and CW drive prohibition	①Check wiring, input terminal uses power ②Correctly set the related parameter
8	Reserved			
9	Encoder fault		Encoder wiring error	Check the wiring
			Encoder damage	Change the motor
			Defective cable of encoder	Change the cable
			Excessive long of encoder cable to cause the encoder voltage low	①Shorten cable ②Power with multi-core parallel

10	undervoltage Control power		Lower control internal 15V input	Check the control power
			①Defective connector insider the power module ② Switch power abnormal ③ Chip damaged	①Change the power module ②Check connector ③Check switch power
11	IPM module fault	It occurs when switching on the control power	Circuit board fault	Change the drive module
		It occurs in the motor operation	①Power supply voltage lower ②Overheating	①Check the drive module ②Power ON again ③Change the drive module
			Short-circuit among the drive unit U, V and W	Check the wiring
			Defective grounding	Correct grounding
			Motor insulation damage	Change the motor
			Interfered	①Increase circuit filter ②Far away from interference source
12	Overcurrent		Short-circuit among the drive unit U, V and W	Check the wiring
			Defective grounding	Correct grounding
			Motor insulation damage	Change the motor
			Drive module damage	Change the drive module
13	Overloading	It occurs when switching on the control power	Circuit board fault	Change the specified drive unit of the AE-100 full electric injection molding machine
		It occurs in the motor operation	Operation with excessive rated torque	①Check loading ②Reduce on-off frequency ③Reduce torque limit value ④Change a bigger power of DST01A injection molding machine drive unit and motor
			Hold brake close	Check the hold brake
			Motor instable oscillation	①Adjust gain ②Increase acceleration/deceleration time ③Reduce loading inertia
			①One phase of U,V and W disconnected for the specified drive unit of AE-100 full electric injection molding machine ②Incorrect encoder wiring	Check the wiring
14	Open-phase alarm		380V 3-phase AC open-phase	Check 3-phase AC power module

15	Encoder counting error		Encoder damage	Change the motor
			Incorrect encoder wiring	Check the wiring
			Defective grounding	Correct grounding
16	Motor heat overloadin	It occurs when switching on the control power	Circuit board fault	Change the specified drive unit of the AE-100 full electric injection molding machine
			Incorrect parameter setting	Correctly set the related parameter
		It occurs in the motor operation	Long time operation with the excessive rated torque	①Check loading ②Reduce on-off frequency ③Reduce torque limit value ④ Change a bigger power for the specified drive unit and motor of AE-100 full electric injection molding machine
17	Speed response slow	It occurs in the motor operation	Speed response deviation excessive big	①Check encoder wiring ②Check whether the parameter configuration is correct. ③Change the drive unit
18	FPGA fault		FPGA version signal read error	Change the specified drive unit of the AE-100 full electric injection molding machine
19	Heat resetting		Instable control power input	Check the control power
			To be interfered	①Increase circuit filter ②Far away from interference source
20	EEPROM Error		Chip or circuit board damage	Change the specified drive unit of AE-100 full electric injection molding machine. Set the specified drive unit type (Parameter No.1) of AE-100 full electric injection molding machine again after alter renovating, and then recover the default parameter.
21	Brake fault	It occurs when switching on the control power	Circuit board fault	Change the specified drive unit of the AE-100 full electric injection molding machine
			Brake resistance wiring OFF ①Brake transistor damage ②Internal brake resistor damage	Wiring again Change a corresponding type drive module
		It occurs in the motor operation	Inadequate brake circuit capacity	①Reduce on-off frequency ②Increase acceleration/deceleration time constant ③Reduce torque limit value ④Reduce loading inertia ⑤Change a bigger power for the specified drive unit and motor of AE-100 full electric injection molding machine
			Main voltage excessive high	Check power module

22	Encoder read error		①Encoder cable damage ②Encoder damaged on motor ③Circuit board damaged of drive module ④Interfered by foreign electromagnetism	①Change encoder cable ②Change the encoder on the motor ③Change circuit board ④Remove interference resource
23	A/D chip error		①Chip or circuit board damage ②Current sensor damage	Change the specified drive unit of the AE-100 full electric injection molding machine
24	Encoder type error	It occurs when switching on the control power	①Encoder selection error ②Parameter setting error	①Change encoder ②Set encoder parameter
31	Encoder write error	It occurs during encoder zero	①Encoder cable damage ②Encoder damaged on the motor ③The electromagnetism interference from outside	①Change encoder cable ②Change the encoder on the motor ③Far away from interference source

## CHAPTER SIX DISPLAY AND OPERATION

### 6.1 Power Module Display

Observe whether the main circuit operation is normal by the ALARM and STATUS indicators on the power module; refer to the following table.

Table 6-1 The display information of power module indicator

ALARM	STATUS	Explanation	Display information
0 ≈1	0		Without main circuit power (AC380)
0	1	STATUS indicator flash	Start resistor burnt (Unrecoverable, it is better to change the start resistance from factory)
0	1	During operation	Main circuit alarms (overvoltage, undervoltage, open-phase and brake)
0	1	At the moment of power off	The power during releasing the main circuit.
1	0		Normal

≈1 0 means OFF, 1 means ON

### 6.2 The Keyboard Operation of Drive Module

- The drive module panel of AE-100 full electric injection molding machine composes of 6 LED nixie-tube displays and 4 buttons  $\uparrow$ ,  $\downarrow$ ,  $\leftarrow$  and  $\text{Enter}$ , which is displayed various states and setting parameter etc. Refer to the following button functions:

$\uparrow$ : Series No. or numerical value increase, or option forward

$\downarrow$ : Series No. or numerical value decrease, or option backward

$\leftarrow$ : Return to the previous operation menu, or cancel the operation

$\text{Enter}$ : Enter the next operation menu, or input the confirmation.

**Note:** Hold the  $\uparrow$  and  $\downarrow$ , the operations are repeatedly performed; the longer of the hold time is, the faster the repeated speed is.

- 6-digit LED nixie-tube displays each state and data of the system; the decimal point of the overall nixie-tube or the most right one flashes, which means the alarm occurs.
- The operation is performed based upon the multilayer menu; the 1<sup>st</sup> layer is main menu, which includes 8 operation methods; the 2<sup>nd</sup> one is the function menu under each operation method. Refer to Fig. 6-1 Main menu operation frame:

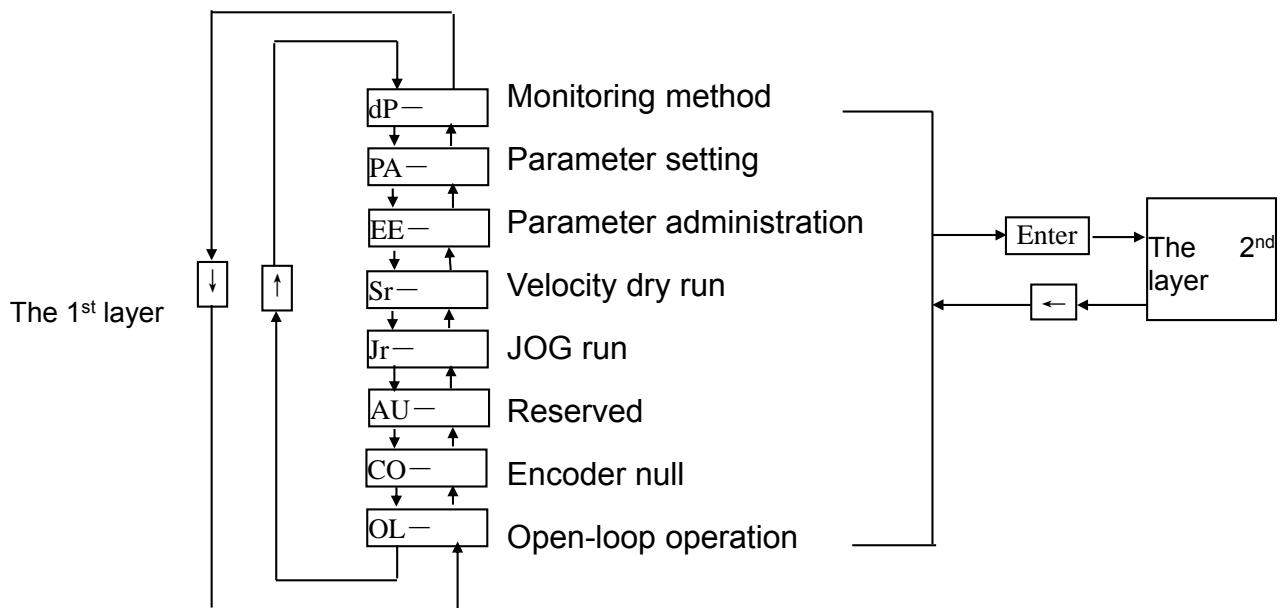


Fig. 6-1 Method operation frame

### 6.3 The Monitoring Method of Drive Module

Select “dP-” at the 1<sup>st</sup> layer, then enter the monitoring method by pressing **Enter**. There are 21 kinds display states, and user select the desired display mode by **↑** or **↓**, enter the concrete display state by the **Enter** again.

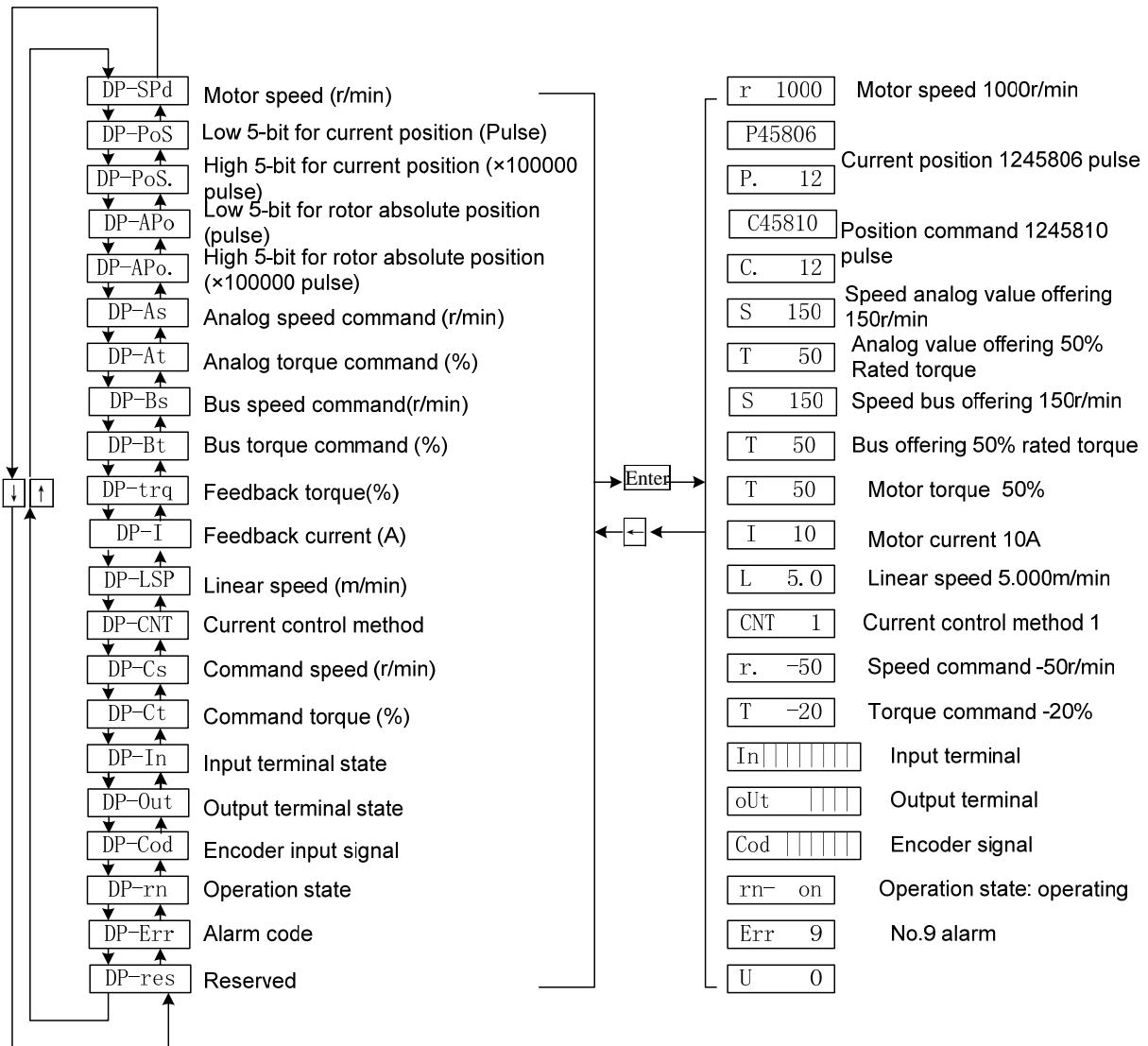


Fig. 6-2 The operation frame of monitoring method

**Note 1:** The pulse value unit is inside the system one. For example: the pulse value expresses with high 5-bit + low 5-bit matching with the 10000 pulse/rotation motor, the calculation method is shown below:

$$\text{Pulse value} = \text{high 5-bit numerical value} \times 100000 + \text{low 5-bit numerical value}$$

**Note 2:** Control method: 1-analog speed + torque control mode; 2-analog speed control mode; 4 -Switch value speed control mode; 5-Speed dry run mode; 6-JOG mode; 7-Analog torque control mode; 8-Industry Ethernet control mode; 10-Encoder zero; 11-Open-loop operation.

**Note 3:** If the display number reaches to 6-bit (For example: -12345), the prompt character will not be displayed.

**Note 4:** The calculation method of the motor current I is as follows:

$$I = \sqrt{\frac{2}{3}(I_U^2 + I_V^2 + I_W^2)}$$

**Note 5:** The rotor absolute position in the one-turn means that the rotor's position related to the stator, for example, one-turn is regarded as a period, its range is 0~131072. The rotor position information is increase counting when motor is positive, and it is decrease one in negative.

**Note 6:** Figure 6-3 shows the input terminal; the Figure 6-4 indicates the output terminal; the Fig. 6-5 displays the encoder signal.

**Note 7:** Operation states are shown below:

“rn- off”: Main circuit uncharged, servo system without operation;

“rn- CH”: Main circuit charged, servo system without operation (Servo without enabling or with alarm);

“rn- on”: Main circuit charged, servo system with operation..。

**Note 8:** “Err --” means normal and without alarm.

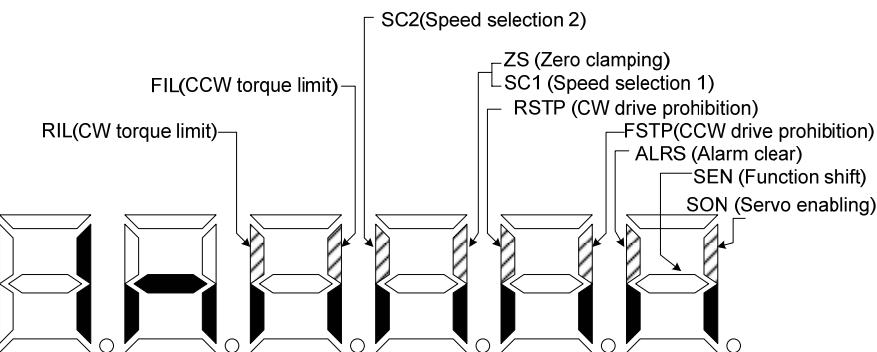


Fig. 6-3 Input terminal display (Stroke lights up that means ON, and vice versa)

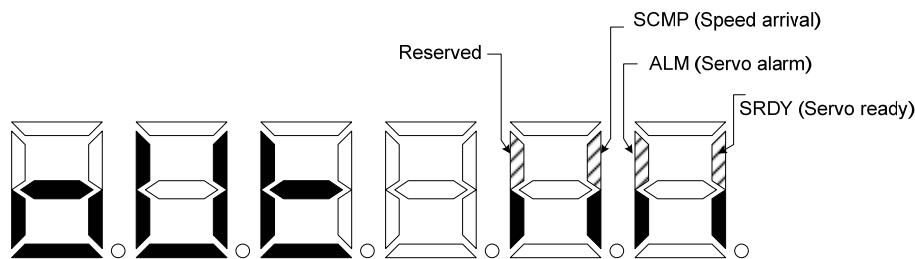


Fig. 6-4 Output terminal display (Stroke lights up that means ON, and vice versa)

## 6.4 Speed Dry Run and JOG Operation



### Notice

- It is recommended that the dry run and JOG operation are performed during motor no-load, guard against the equipment accident.
- The specified drive unit SON (Servo enabling) of the AE-100 full electric injection molding machine should be enabled, and the CCW, CW drive prohibition should be disabled.

Speed dry run method: The speed command can be changed by the  $\uparrow$ ,  $\downarrow$  buttons in this method.

The motor will operate based upon the supplied speed and direction. It is only used by the factory.

JOG operation method (JOG operation method): Press the  $\uparrow$  and hold it, the motor operates according to the JOG speed; the motor stops releasing this button and hold zero speed; press  $\downarrow$  and hold it, the motor reversely operates based on the JOG speed; the motor stops releasing this button

and hold zero speed. It is only used by factory.

## 6.5 Analog Speed Operation

Set the parameter No.4 to 2, select the analog speed operation mode.

The CN1-5(SPD\_REF) pin of the servo CN1 terminal is connected with the external speed command input, and the CN1-15(SPD\_GND) pin is connected with external analog speed signal grounding. The motor rotation speed can be controlled by adjusting the external analog input value.

The servo motor operation speed of the external analog voltage 10V can be set by the parameter No.42.

**For example:**

Parameter No.42 = 1500 means that the motor's top speed is 1500r/min (factory setting) when it is set to 10V input.

Parameter No.42 = 3000 means that the motor's maximum speed is 3000r/min when it is set to 10V input.

**Precaution:** The setting of the parameter No.23 will affect the actual speed of the motor. The motor speed is 1500, if the parameter No.23 is set to 1500, the parameter 42 is set to 3000 and the external input is set to 5V. However, the motor's speed will hold at the 1500 even if the analog voltage increases consecutively. Accordingly, the setting value of the parameter No.23 should be modified at the same time to meet the capacity requirements.

## 6.6 Analog Torque Operation

Set the parameter No.4 to 7, select the analog torque operation mode.

The CN1-7(TQ\_REF) pin of the servo CN1 terminal connects with the external command input; the CN1-11(TQ\_GND) pin connects with the external analog signal grounding. The motor torque can be controlled by adjusting the external analog input value.

The servo motor torque output value corresponding to the external analog voltage can be set to 10V by the parameter No.44.

**For example:**

Parameter No.44 = 100 means the setting motor at the rated torque operation when it is set to 10V input. (Factory setting).

Parameter No.44 = 300 means that the setting motor is 3 times operation of the rated torque when it is set to 10V input.

The top torque of the speed arrival is determined by the parameter No.45 and 23 together. The maximum speed is the minimum value between parameter No.45 and 23.

## 6.7 Analog Speed + Analog Torque Operation

Set the parameter No.4 to 1, select the analog speed + analog torque operation mode.

The CN1-5(SPD\_REF) pin of the CN1 terminal connects with the external speed command input; the CN1-15(SPD\_GND) pin connects with the external analog speed signal grounding; the CN1-7(TQ\_REF) pin connects with the analog speed command input; CN1-11(TQ\_GND) connects with the external analog torque signal grounding. The speed and torque can be separately controlled in this control mode.

Refer to the Section 6.7 analog speed operation and the Section 6.8 analog torque operation for the parameter setting method.

## 6.8 Other Control Methods

The encoder zero function is used only by factory, user can not perform it.

The open-loop method is only used by factory, user can not perform it.

## 6.9 Analog Value Input Command Zero

Although the command voltage is set to “0V”, the motor may still perform with a slight speed when the speed and torque are controlled. This is caused with the slight value (mV Unit) “offset” from the previous level equipment or external command voltage. The zero modification can be performed by the Parameter No.41 analog speed and No.43 analog torque command zero modification values; the external analog input value is set to “0V” by this “offset value”; the values both the DP-As and DP-At are treated as zero, and then the motor will not perform the slight rotation offset.

## CHAPTER SEVEN POWER-ON OPERATION

 **Notice**

- The specified drive unit and motor of AE-100 full electric injection molding machine should be grounded, PE terminal should be connected with the equipment grounding.
- It is recommended that the specified drive unit power of the AE-100 full electric molding machine is provided by the insulation transformer and power filter to ensure the safety and anti-interference performance.
- The power can be turned on after confirming the wiring is absolutely corrected.
- It is necessary to connect an ESP circuit to ensure the power can be immediately stopped when fault occurs (Refer to the Fig. 7-1).
- After the fault for the specified drive unit of AE-100 full electric injection molding machine alarms, it is important to confirm that the fault is removed and the SON is disabled before restarting the machine.
- Do not touch the specified drive unit and motor of the AE-100 full electric injection molding machine after the power is turned off for 5min. at least to prevent the electric shock.
- The specified drive unit and motor of the AE-100 full electric injection molding machine may heat up after it operates for a period time to avoid burnt.

### 7.1 Power Connection

Refer to the Fig. 7-1 for the power connection, and connect the power based upon the following sequence.

- 1) The power is connected to the input terminal R, S and T of the injection molding machine power module DTS02A-POW. The DC bus output terminal P and N of the servo drive power module are separately connected to the P and N input terminals of the servo drive module. Wherein, the power module PB and D should be connected with a brake resistance.
- 2) The power r, t of the control circuit is connected with the power module or prior to the main circuit; if only the control circuit power is turned on, the servo ready signal (SRDY) is then OFF.
- 3) The main circuit power delays 1.5s after it is turned on, servo ready signal (SRDY) ON. In this case, the servo enabling (SON) signal can be accepted, and then inspect an effective servo enabling. The specified drive unit output of the AE-100 full electric injection molding machine is enabled and the motor excites in the operation state. The servo enabling is disabled or alarms, the PWM circuit inside the drive module closes and the motor is on the electric brake state.
- 4) The PWM circuit is turned on after 1.5s when servo enabling is connected with the power.
- 5) The soft-start and dynamic brake circuits may be damaged frequently turning on/off the power; up to 5 times/hour and below 30 times/day of the on/off frequency. The power can be turned on again after cooling 30min when the fault is removed if the specified drive unit or motor of the AE-100 full

electric injection molding machine is overheating.

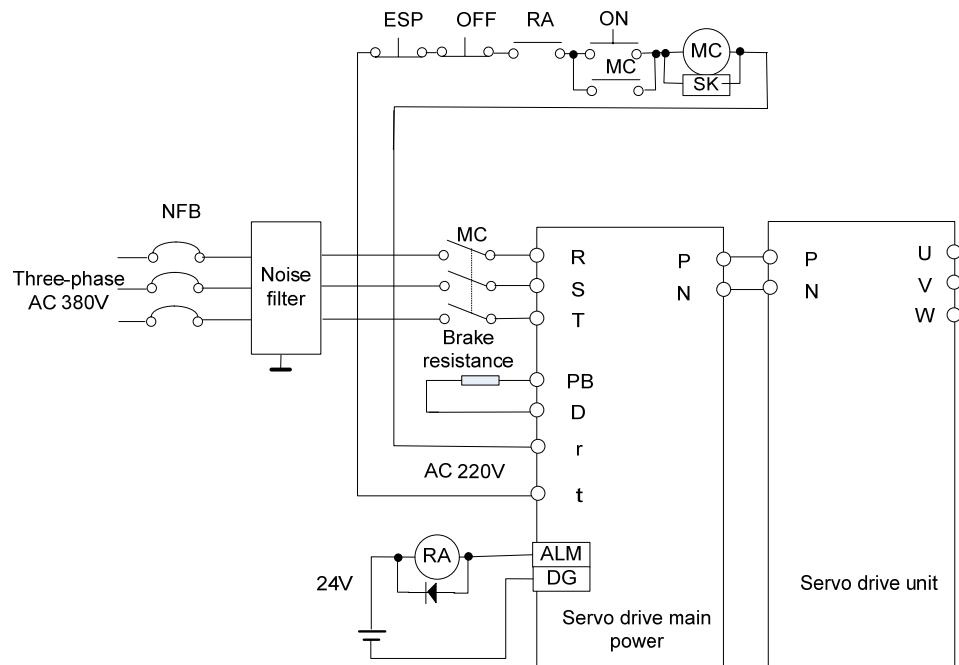


Fig.7-1 Drive unit power module connection diagram

Power-on time sequence and alarm sequence:

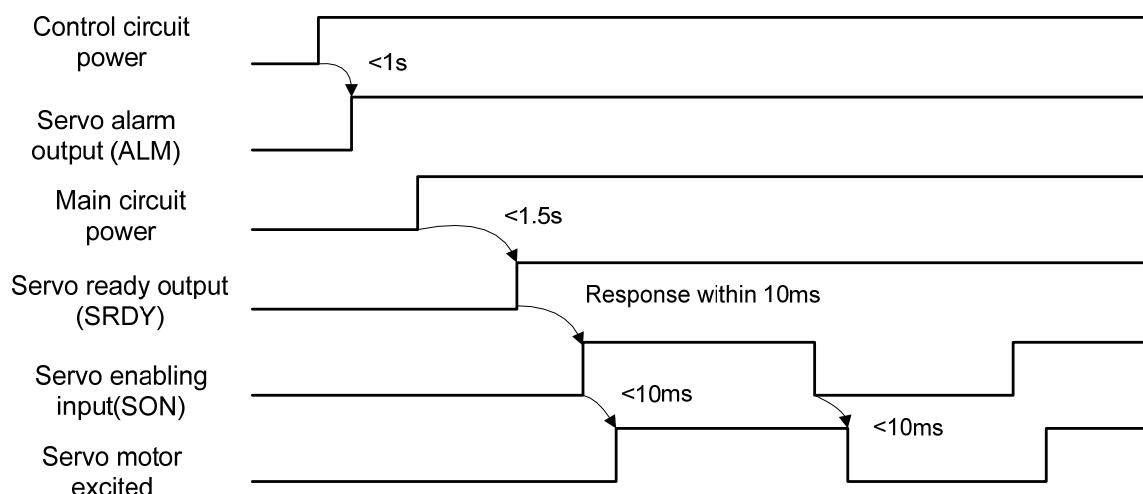


Fig. 7-2 Power-on time sequence

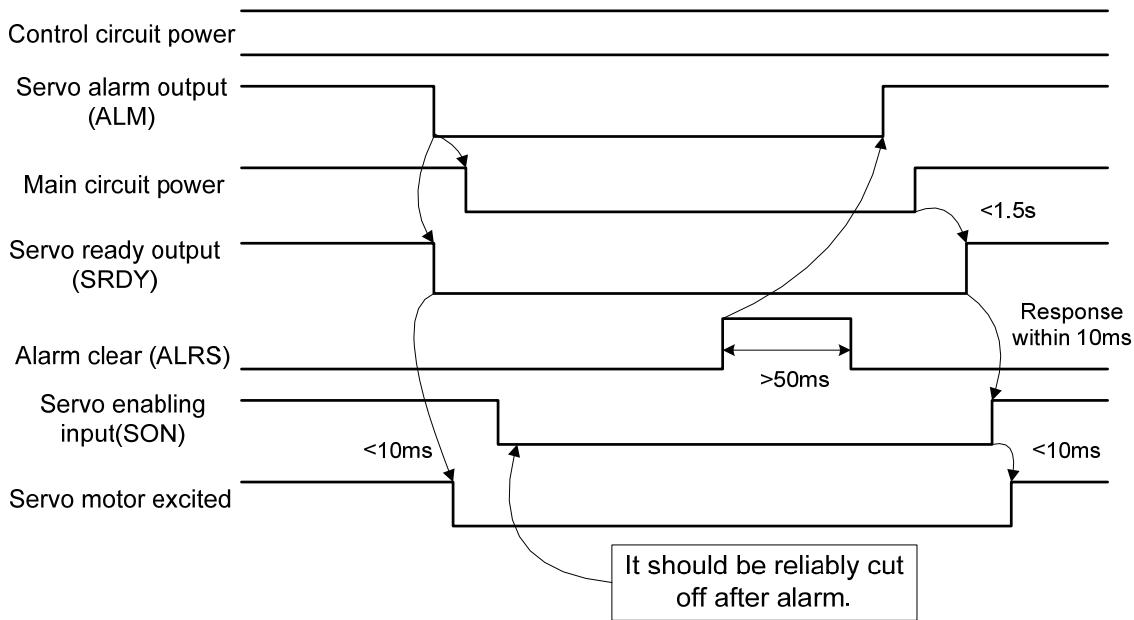


Fig. 7-3 Alarm time sequence

## 7.2 Inspection Before the Operation

Firstly, inspect the following items before the power is turned on, meanwhile after the installation and connection are performed.

- Inspect whether the power terminal wiring is correct and the input voltage is reliable and proper.
- Inspect whether the power and motor cables are short-circuited or grounded.
- Inspect whether the encoder cable connection is correct.
- Inspect the control signal terminal connection is accurate and the power polar and dimension are correct.
- Inspect the specified drive unit and motor of AE-100 full electric injection molding machine is firmly fixed.
- Inspect whether the motor shaft is connected the loading.

## 7.3 Motor Response Adjustment

### Notice

- Incorrect parameter setting may cause equipment damage and hazard; confirm whether the parameter is correct before starting.
- It is recommended to perform the loading debugging after the no-load one is executed.

## ● Analog speed control

- (1) [Speed proportional gain] The setting value of the parameter No.5 is set as bigger as possible without vibration. Generally, the bigger the loading inertia is, the bigger the setting value of the [Speed proportional gain] is.
- (2) [Analog speed command modification value] The setting value of the parameter No.41 is the zero offset compensation value of the analog speed input. The setting value of the parameter No.42 is set the maximum analog voltage corresponding top motor rotation speed. The setting value of the parameter No.18 is the low-pass coefficient of analog speed input; the bigger the setting value is, the higher the cut-off frequency is.
- (3) [Speed integral time constant] The setting value of the parameter No.6 is set as bigger as possible based upon the specified condition. The response speed may rise when the [Speed integral time constant] is set to excessive big, but it is easy to vibrate. And therefore, it is better to set as bigger as possible without vibration condition. The speed appears a bigger change along with the loading alteration when the [Speed integral time constant] is set as excessive small. In general, the bigger the loading inertial is, the smaller of the setting value of the [Speed integral time constant] is.

## ● Analog torque control

- (1) Set the suitable [Speed proportional gain] and [Speed integral time constant].
- (2) [Analog torque command modification value] The setting of the parameter No.43 is zero offset compensation of analog input. The setting of the parameter No.44, set the top analog voltage corresponding the maximum motor torque (percentage rated torque). The setting of the parameter No.19 is the analog torque input low-pass filter coefficient; the bigger the setting value is, the higher the cut-off frequency is.

# CHAPTER EIGHT PRODUCT TECHNOLOGY SPECIFICATION

## ⚠️ Notice

The specified drive unit of the AE-100 full electric injection molding machine should be matched with the servo motor; this manual describes the adapted GSK SJT series servo motor. It is better to note before ordering if user matches other factory's servo motor.

## 8.1 The Technology Specification of Power Module

Table 8-1 The specified drive unit main power parameter of AE-100 full electric injection molding machine

Item	Type	DTS02A-POW
Rated output power (kW)		42.7
Input voltage (V)		AC 380V
Output voltage (V)		DC 538V
Pressure (V)		800
Brake resistance (Ohm)		10
Brake resistance power (W)		2000

## 8.2 The Technology Specification of Drive Module

Table 8-2 The specified drive unit main parameter of AE-100 full electric injection molding machine

Drive module type	DTS01A-50	DTS01A-100	DTS02A-200	DTS02A-450			
Input power	Bus voltage DC 538V						
ambient use	Temperature	Working: 0°C~55°C Storage & transportation: -20°C~+70°C					
	Humidity	Less than 90% (Without condensation)					
	Vibration	Less than 0.5G (4.9m/s <sup>2</sup> ), 10 Hz~60 Hz (Non-consecutive operation)					
Control method		(1) Analog speed + analog torque (2) Analog speed control mode (4) Switch value speed control mode (5) Speed dry run mode (6) JOG mode (7) Analog torque control mode (8) Industry Ethernet control mode (10) Encoder zero method (11) Open-loop mod					
Regeneration brake	External						
Control character	Speed frequency response: ≥200Hz						
	Speed wave rate: <±0.03 (Loading 0~100%); <±0.02× (0.9~1.1) Power voltage (The numerical value corresponds the rates speed)						
	Speed-regulation ratio: 1:5000						
	Signal input	Speed command input	Command voltage	Voltage range DC±10V			
		Torque command input	Command voltage	Voltage range DC±10V			
Internal speed	There are 4 internal speed modes can be selected based upon the external control input signal						

Control input	①Servo enabling ②Alarm clear ③CCW drive prohibition ④CW drive prohibition ⑤Speed selection 1/zero speed clamping ⑥Speed selection 2 ⑦CCW torque limit ⑧CW torque limit ⑨Control method shift			
Control output	①Servo ready output ②Servo alarm output ③Speed arrival output			
Acceleration/deceleration function	Parameter setting acceleration/deceleration time 1 ms~10000ms (0r/min~1000r/min)			
Monitoring function	Rotation speed, current position, motor torque, motor current, linear speed, rotor absolute position, operation status, input/output terminal signal, analog speed input, analogy torque input command etc.			
Protective function	Overspeed, power module overvoltage/undervoltage, overcurrent, overloading, brake abnormal, encoder abnormal, control power abnormal etc.			
Display, operation	6-bit LED nixie tube, 4 buttons			
Available loading inertia	Less than the 5 times of motor inertia			
Dimension (mm)	497×120×324	497×200×324	497×250×324	497×250×324

### 8.3 Servo Motor Specification

The following table is the parameter explanation of AE-100 full electric injection molding machine standard configuration servo motor. The motor specifications may differ from the product alteration; it is better to touch the factory or refer to the machine itself.

Table 8-3 The main parameter of AE-100 standard configuration motor

Item \ Type	175SJT-M180DH (A4IY3)	175SJT-M500BH (A4IY2)	220SJT-M700BH (A4IY1)	265SJT-M2400B H(A4IY1)
Polar logarithm	3	3	4	4
Drive module input voltage (V)		AC 3-phase 380		
Rated current (A)	9.5	20	35	62
Rated torque (N·m)	14.5	50	70	191
Zero speed torque (N.m)	18	50	70	240
Rated speed (r/min)	2500	1500	1500	1500
Top speed (r/min)	3000	2000	2000	1600
Rotor inertia (kg·m <sup>2</sup> )	$6.5 \times 10^{-3}$	$14.8 \times 10^{-3}$	$21.6 \times 10^{-3}$	$45.3 \times 10^{-3}$

**Note:** Refer to the motor user manual for the concrete parameters and specifications.