

**IQT Series Intelligent Quarter-turn Electric Valve Actuator**

**IQTEx Series Explosion-proof Intelligent Quarter-turn Electric Valve Actuator**

**Operation Manual**



**Tianjin Baili Ertong Machinery Co., Ltd.**

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# Part I Summary of the Intelligent Electric Actuator and Setting

## 1. Summary

IQT series intelligent quarter-turn valve electric actuator (hereafter referred as “electric actuator”) is an electrically and mechanically integrated product. It is applied to control butterfly valve, ball valve, cock valve and other similar mechanism which make 90°turns.

This Manual Operation is used for IQT series standard quarter-turn valve electric actuator and IQT Ex series explosion-proof type quarter-turn valve electric actuator. If there is more to this, extra instruction will be offered.

## 2. Primary technical parameters

2.1 Power supply: Standard: 380V 50Hz three-phase three-wire system, sine AC; 220V, 50Hz single-phase sine AC (Non-standard power supply should be confirmed when user places order, and it should be indicated on the nameplate.)

2.2 Control signal: active contact or passive contact: 24VDC、<10mA/contact,pulse width $\geq$ 100ms;  
Remote positioning control signal 4~20mA ( $R_i \leq 250\Omega$ ).

2.3 Output signal: valve position signal 4~20mA ( $R_o \leq 600\Omega$ );  
Dry contact signal for status: 250VAC/0.5A, 24VDC/3A

2.4 System configuration:

- a. Local control switching value and remote control switching value
- b. Valve position output: 4-20mA
- c. One monitoring relay; 8 configurable status relays
- d. 4-20mA remote positioning control or field bus control (Profibus DP or Modbus are also provided if place order.)

2.5 Enclosure protection grade: IP67 (IP68 can be provided if place order)

2.6 Working ambient temperature: -20°C~+70°C (if user's requirement is not in this range, please notify when ordering.)

2.7 Ambient relative humidity: be up to 90% (at 25°C)

2.8 Working environment: without strong corrosive medium and explosive mixed gas (please refer to Part III for explosive-proof products)

## 3. Primary protection function

Rated torque protection: when the motor is locked-rotor (valve position is smaller than 1% in 7 seconds), the operation direction is forbidden. Hand wheel operation and contrary direction operation can remove the protection.

Phase-loss protection: three-phase power supply is of phase loss, and then the actuator is forbidden to be operated.

Switching protection for operating direction: reversed direction protection has been set up in order to protect electric actuator and valve. The operating actuator will stop working at the time when it received an order of switching protection for operating direction. The actuator will go to reversed direction during the protection time (at least 0.5s).

Torque protection\*: When the set torque value is exceeded in the operating direction, the operating will be prohibited. Release such protection by reverse operating or operating with hand wheel.

Over-heated protection\*: the motor is working successfully for a long time or, the motor is getting over-heated due to other reasons; then, The operating will be prohibited when the embedded temperature switch in the motor trips until it is reset.

Over-current protection\*: The motor will be prohibited to run when it is subjected to over current for long as this indicates some faults existing with the motor.

Notice (Items with \*): ESD (emergency shutdown) should be given priority when it meets these protection functions with “\*”. Please refer to ESD for more details.

## 4. Setting up

### 4.1 Stem joint

There are two types of stem joints supplied together with the electric actuator. (Users can select either type.) One of them is fixed at the bottom of output shaft of the electric actuator with four screws. The other is connected to output shaft with an involute spline.

#### 4.1.1 Connection of stem joint (with four screws):

- a. Remove the stem joint: remove the stem joint by using L spanner.
- b. Machine the stem joint: according to the stem diameter and key dimensions, machine the stem joint's key and key slot. The direction and position of key slot should be aligned with the direction of one of the 4 screws on the stem joint.
- c. Re-fit the stem joint.
- d. According to the direction of electric actuator connected with valve, select one direction of key slot on the stem joint. (There are four types fixing positions on the valve for the electric actuator. User could select one of them according to his need.)
- e. Check if the opening and closing directions of the electric actuator accord with that required by the valve.
- f. Insert the stem joint into the output shaft hole and fasten the four fastening screws by using L spanner.

#### 4.1.2 Connection of involute spline joint

- a. Remove spline joint and, according to stem diameter and key dimensions, machine the hole and key slot of stem joint.
- b. Put the machined stem joint into output shaft in the direction of stem key slot, if it does not fit, make a fine adjustment by turning the joint circumferential for one tooth. Stem joints are shown in the figure below:



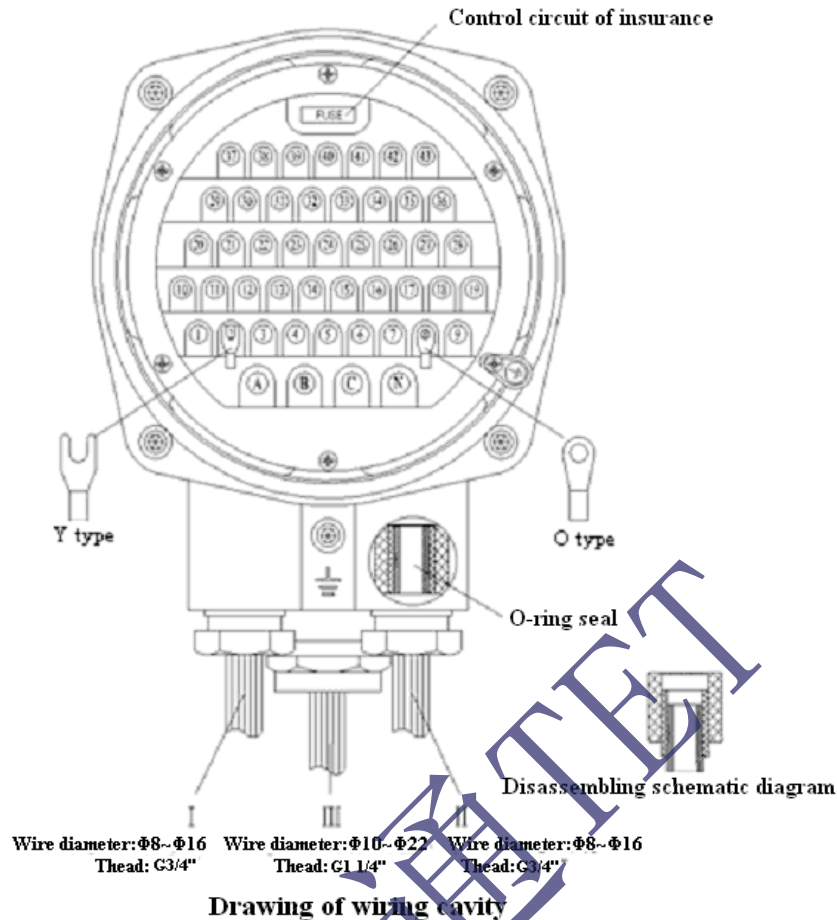
### 4.2 Connection between electric actuator and valve

The flange used to connect with valve complies with ISO 5211, which will ensure that electric actuator is correctly connected with valve through stem joint. Refer to the Product Catalogue for detailed connection type and specifications.

## 5. Lubrication and maintenance

- 5.1 After the product maintenance, please pay attention to lubricating grease's oxidability, heat resistance, anti-rust property, mechanical stability, compressive property to keep the product's in a good lubricating property with a good performance of transmission efficiency (specialized lubricating grease is recommended).
- 5.2 Inject lubricating grease without any foreign matter and then seal the injecting parts.
- 5.3 Regular maintenance for actuator should include:
  - a. Fasten the bolt set between the actuator and the valve every six-operation months.
  - b. Keep the valve stem and driving shaft sleeve clean and lubricated.
  - c. If the valve is seldom operated, please actuate periodically (usually three or four months at intervals).

## 6. Electric wiring



### 6.1 Remove terminal box cover:

Unscrew the 4 screws on terminal box cover with an Allen key, remove the box cover and make connections according to the electric wiring diagram.

### 6.2 Wiring manner of electric actuator:

The lead shall be connected via lug plate. It is not allowed to direct connect leads to the terminals. Users should refer to the electric schematic diagram. Power supply input cable and control cable shall be connected through separate slots. Refer to Part III “Intelligent explosion-proof wiring steps” for more details.

### 6.3 Inlet cable specification

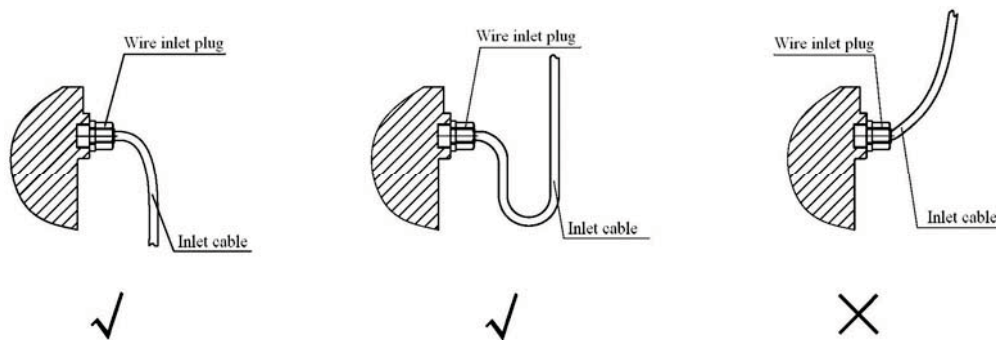
The seal ring of inlet interface can be changed according to outer diameter of cable. The range of interface I and II is:  $\phi 8 \sim \phi 16$  and the range of interface III is:  $\phi 10 \sim \phi 22$ . Properly handle the sealing work between the inlet cable and inlet apparatus after wiring, in case of sealing performance could be weakened.

### 6.4 Thread diameter specification

The pipe screw thread specification of interface plug I,II is G3/4. The pipe screw thread specification of interface plug III is G1 1/4.

### Warning:

- User should apply shield multi-core wires, shielding layer should be single-end earthed. Must make sure the input signal control cable, output signal control cable and power cable are separately laid in grooves.
- Please make sure the PE terminal is safely connected.
- Cable should be set up correctly to avoid the rain leaking into the electric actuator (the first two connection patterns in the figure below are right).



## 7. Notice

- 7.1 Protect the display window glass and local control switch button from impact.
  - 7.2 Forbid to mount or open wiring box in a bad weather outside.
  - 7.3 Cut off power before open the wiring box case.
  - 7.4 The selection of motor's power should comply with actuator's output torque and speed. User cannot change at one's will.
  - 7.5 Each part of the actuator should be fastened firmly.
  - 7.6 Actuator should be reset before it will mount against valve.
  - 7.7 In manual operation, push the switch handle according to the arrow and properly turn the handwheel until the handle fully switched to the right position. At this point, electric-manual switching is finished. Turn the handwheel to start manual operation.
  - 7.8 In manual operation mode, it is forbidden to add a case or insert a stick to turn the handwheel.
  - 7.9 When the valve is seldom used, a system of regular inspection should be established if permitted by pipeline system.
  - 7.10 Unused electric actuator should be placed in dry environment without corrosive material.
  - 7.11 The design service life of actuator is 8000 times.
  - 7.12 According to the regulations on the recycling and treatment of waste electrical and electronic products, please comply with the relevant national regulations and properly dispose of waste products. Or call our after-sales service department for recycling. Tel: 022-26740033.
  - 7.13 Service commitment: When the equipment breaks down, please contact the technical responsible person appointed by our company at first, and we will provide processing opinions and technical support within 24 hours. If necessary, we will send technical personnel to the user site within 72 hours in the city, 3-5 days reaches the user site according to the distance outside the city until the problem is solved.
- Complaints Tel: 022-26740033; Hotline: 022-26740033

## Part II Setting and Debugging for the Intelligent Electric Actuator

### 1. Operation methods of electric actuator

#### 1.1 Local operation

##### 1.1.1 Electric operation

Shown in Fig.2, select button is on the left corner and operation button is on the right side. Select button: Local-Stop-Remote; turn the operation button clockwise is to close the valve and turn the operation button counterclockwise is to open the valve. Turn the select button to 'Local', and then counterclockwise turn the operation button, so the actuator will working in the direction of opening the valve. Turn the operation button clockwise and the actuator will work in the direction of closing the valve. Unclench the button and the actuator will stop working.

### 1.1.2 Manual operation

Turn the select button to “Stop” before start manual operation. Push the switch handle to manual operation according to the arrow (turn the handwheel slowly when push the switch handle so as to make the clutch engage with the gear). At that time, handwheel manual operation is achieved.

Manual/Electric switch operation applies semi-auto electric design. The clutch will automatically switch into electric operation at the time when the motor is rotating.

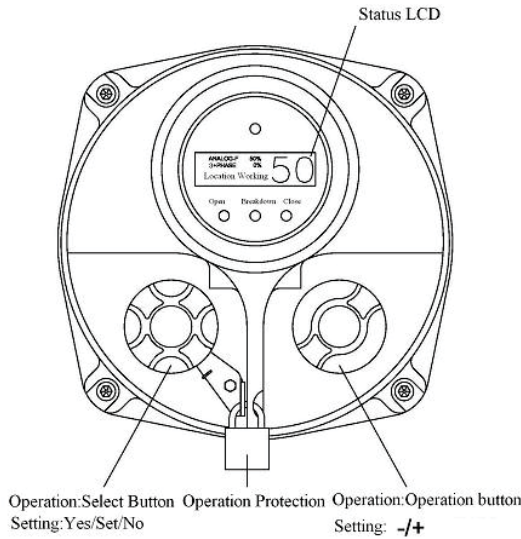


Fig.2

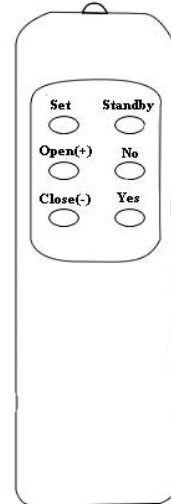


Fig.3

### 1.2 Remote operation (see Fig.3)

#### 1.2.1 Basic performance of the setter:

Effective distance for usage: be shorter than 2 meter

Battery change: two AAA 1.5V(7#)

#### 1.2.2 Remote setter function

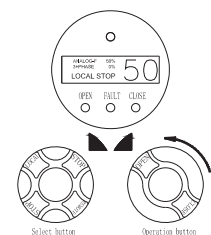
Keys on remote setter	Function
Set	Set up the system's parameters
Open(+)	In the opening direction ; In the setting interface, to see the next function or add one more value
Close(-)	In the closing direction ; In the setting interface, to see the previous function or minus one more value
No	In the setting interface, to return to the previous menu or exit from setting interface
Yes	In the setting interface, to confirm a newly set function or value.

### 1.3 Selection knob parameters operation

#### 1.3.1 Start to set up parameters

Step I: turn the selection button to “Stop” position to make the electric actuator to stop working.

Step II: Turn the operation button to the “Open” position and keep it at this position



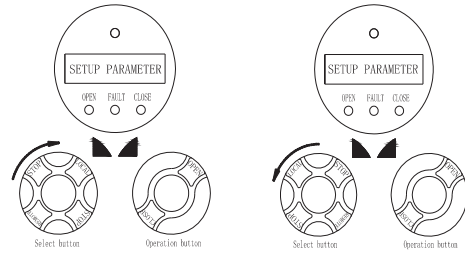
for 5 seconds.

### 1.3.2 “OK” set up

Step I: turn the select button to the “local” position.

Step II: turn the select button to the “Stop” position.

Note: If the button is at “Local” for 5 seconds or more, system will exit from parameter setting up interface and will be back to “Stop” status.

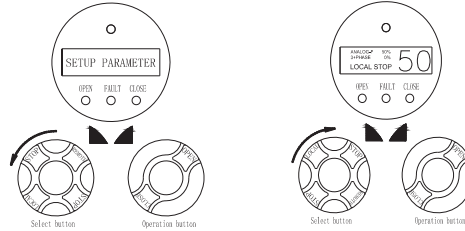


### 1.3.3 “Cancel” operation

Step I: turn the select button to “Remote”.

Step II: turn the select button back to “Stop” position.

Note: If the select button is on “Remote” position for 5 seconds or more, system will exit from parameter setting up status and will be back to “Stop” working status.

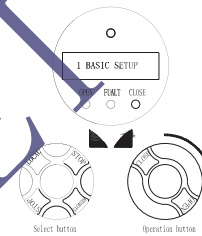


### 1.3.4 “+”operation

Step I: To turn the operation button to the “Close” position.

Step II: To turn the operation button back to the “middle” position.

Note: If the operation button is on “Close” position for 2 seconds or more, the parameters value will continuously change.

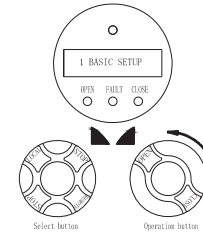


### 1.3.5 “-”operation

Step I: turn the operation button on the “open” position.

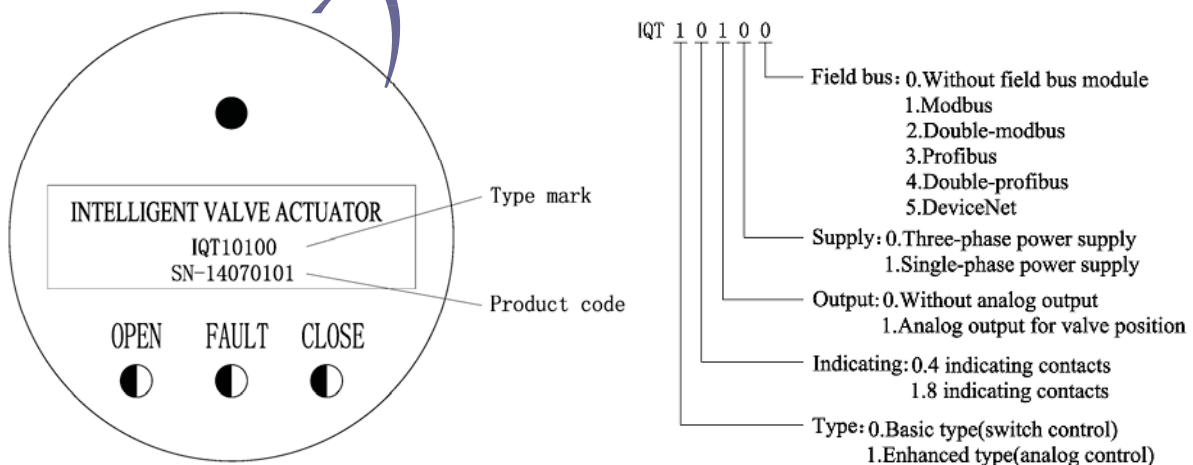
Step II: turn the operation button back to the “middle” position.

Note: If the button is on “open” position for 2 seconds or more, the parameters will continuously change.



## 2. Instruction for status display

### 2.1 Instruction for start-up status



### 2.2 Summary of actuator display

Display component:

- a. Infrared receiving sensor
- b. LCD Display



- c. Valve closing indicator
- d. Malfunction indicator
- e. Valve opening indicator

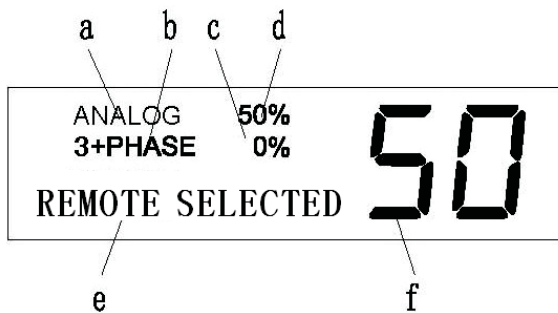
After the power supply is turned on, the pistachio-background lamp on the actuator LCD will light. The LCD is used to display operating mode, opening position (expressed by value between 0% and 100%), fault reason and parameter when setting, etc.

Definition for three indicators: open (red); malfunction (orange); close (green).

Open or close indicator is on, which refers to open limit position or close limit position. Open or close indicator is flashing, which refers to the actuator is working. Open or close indicator and malfunction are on at the same time, which refers to the malfunction in corresponding direction. Malfunction indicator is always lighting, which means valve cannot work properly; malfunction indicator is flashing, which means a common warning malfunction, but can also perform part of the function and maintenance is needed.

### 2.3 Working status display for electric actuator

#### 2.3.1 LCD Display component



- a. Display for control signal source or working system and operating current  
(only displayed when valve stops working)  
ANALOG-F: Remote positioning control  
Analog-R: Remote local positioning  
ON-OFF: Remote switch control (normal operating)  
ON/OFF: Remote switch control (intermittent operating)  
STOP: Stop working  
LOCAL: Local working  
(Only displayed when valve is working)  
0.10(~25.5A): Current value of motor

- b. Motor and contactor status display  
(Only display when valve stops)  
3+PHASE : positive phase sequence  
3-PHASE : reverse phase sequence  
SINGLE : Single phase

#### 2.3.2 Status indication (e)

Function category: working mode indication; operation indication

2.3.2.1 Working mode indication: when "REMOTE" displayed, it refers to working mode.

2.3.2.2 Operating status indication:

The remote positioning control of the actuator is

M-LOSE: phase-loss on motor side

P-LOSE: phase-loss on power supply

1.5XCR: 1.5 times of over-current

2.0XCR: 2 times of over-current

3.0XCR: 3 times of over-current

(only display when valve is operating)

KM1 10: contactor1 is actuated, positive phase sequence

KM2 10: contactor2 is actuated, positive phase sequence

KM1 50: contactor1 is actuated, reverse phase sequence

KM2 50: contactor2 is actuated, reverse phase sequence

c Torque diagnosis display

(only display when valve is operating)

100%: normal

OVER: over-torque

d Display for remote control signal

0 (~100%) : remote positioning signal value

Low: control signal is offline

High: control signal is transfinite

e State information display area

Work status, alarm and fault state of text display alternately

f Valve opening display area

Valve opening display values

full-stroke operating; another is remote positioning control limited-range stroke operating

(1) Opening/closing valve status(non-motion status):

Display “OPEN/CLOSE LIMIT SW REACHER”: Opening/Closing-valve indicator constantly lights, Fault indicator twinkles, which indicates limit switch is acting.

Display “OPEN/CLOSE LIMIT POSITION”: Opening/Closing-valve indicator constantly lights, which indicates valve is fully open/closed.

Display “LMT-RANGE OPENED/CLOSED POSITION”: Opening/Closing-valve indicator constantly lights, which indicates valve fully opened in limited range operating

(2) Valve in motion or non-motion status

Display “RUNNING OPEN/CLOSE”: Opening/Closing-valve indicator constantly lights, which indicates valve is running open/close.

Display “MIT”: Indicate valve in status of stop and being stable or motion check timer working

Display “MID-TRAVEL POSITION”:indicate valve is stopped at non-fully open/closed position.

Display “INT”: indicate valve is in the status of interrupter operation timer working

2.3.2.3 Alarm status indication:

(1) Valve alarm indication

Display “OPENING/CLOSING OVER-TORQUE”: Opening/Closing-valve indicator constantly lights, and fault indicator twinkles, which indicates that the detected torque value exceeds the maximum torque set value in the operating direction, the electric operation in this direction will be prohibited. Letting the actuator to operate in reverse direction can remove the alarm indication. (Subject to overriding of ESD)

Display “OPENING/CLOSING BLOCKED”: Opening/Closing-valve indicator constantly lights, and fault-indicator twinkles, which indicates motor is locked (movement of valve position is less than 1% in 7 seconds). The electric operation in this direction will be prohibited in order to protect the motor. Letting the actuator to operate in reverse direction can remove the alarm indication. When the actuator is in setup status, locked protection will be automatically removed.

(2) Control system alarm indication:

Display “ESD”: Fault-indicator twinkles. ESD signal is efficient. Actuator will perform control of stay put, operating to opened, closed or a designated position according to pre-setting.

Display “SIGANAL LOST”: Fault-indicator twinkles, which indicates that input signal is lost when remote-positioning control is selected. The actuator is out of control and it will perform control of stay put, operating to opened, closed or designated position according to pre-setting.

(3) Electric actuator alarm indication:

Display “POWER PHASE LOST”: fault-indicator constantly lights, which indicates there is phase loss with power supply. The electric actuator is prohibited to operate. Control system of the electric actuator is electrified by two phases of power supply. The control system cannot work in case that there is two phases loss, and without any display;RL0 is inactivated.

Display “MOTOR PHASE LOST”: Fault-indicator constantly lights, which indicates that the electric actuator detects that there is phase loss with motor coil. The electric actuator shall be prohibited to operate. Here it can be taken as failure in contactor or relevant main circuit, and you should turn off the power and perform troubleshooting.

Display “MOTOR OVERHEAT”: Fault-indicator constantly twinkles, which indicates that after the thermistor of the motor trips, the electric operation is prohibited. When the temperature of the motor falls to the level that allows the temperature switch resumes, the alarm display will disappear. (Subject to overriding of ESD)

Display “MOTOR OVERCURRENT”: Fault-indicator twinkles, which indicates motor works overtime and over rated current, the electric actuator is prohibited. Go to setup or turn the “Open/Close” button to “Open”

position for 15 seconds. Then the alarm display will disappear (Subject to overriding of ESD).

Display “MOTION OBSTRUCTED”: Fault-indicator twinkles, which indicates the motion of the valve is obstructed before it reaches the target position as a result of over moment, jammed, over current, phase loss and so forth.

Display “VALVE JAMMED”: Fault-indicator lights, which indicates that after the valve is blocked in a direction, and when the travel of reverse operation is less than 2%, the valve is also blocked in this direction, and in this case electric operation is prohibited.

For removing the alarm, operate manually for a travel of over 2% or enter setting mode or turn the opening-valve/closing-valve knob to “Opening-valve” for over 15 seconds.

### 3. Debugging for the electric actuator

#### 3.1 Confirm the direction

User should first confirm if valve’s rotation direction is the same as that of actuator. Factory settings of the closing direction of the actuator is clockwise. If they are not the same, please go to set the closing direction of the actuator the same as that of the valve.

To turn the select button at the “stop” position. Press “Set” key to go into the setting interface; press “+” or “-” key to select <setup parameter>; press “Yes” to enter <input password>; press “+” or “-” to change the number value and then again press “Yes”. Make repeated operation to enter the password “1234” set upon delivery to enter system setting interface.; Press “+” or “-” key to choose <basic setup>; press “Yes” to go into the subordinate interface; Press “+” or “-” key to choose <close direction> and press “Yes” to go into the subordinate interface; press “+” or “-” to choose “anti-clockwise” and press “Yes”. Setting is finished. Last, press “No” to exit until where you want.

#### 3.2 Setting up the open limit position and close limit position:

There is requirement on the setting sequence of open limit position and close limit position. User could either first set up close limit position or open limit position.

##### 3.2.1 Setting up for open limit position

To turn the manual-electric switch handle to the Manual-mode position; to turn the handwheel to make the valve fully-open.

To turn the select button at the “stop” position. Press “Set” key to go into the setting interface; press “+” or “-” key to select <setup parameter>; press “Yes” to enter <input password>; press “+” or “-” to change the number value and then again press “Yes”. Make repeated operation to enter the password “1234” set upon delivery to enter system setting interface. Press “+” or “-” key to choose <basic setup> and press “+” or “-” key to choose <open limit position> and then press “Yes” to go into calibration interface; press “Yes”, and “◆” begins to flash, press “Yes” to set up this position as the valve’s open limit position (Calibration could be made many times.). Last, press “No” to exit to where you want.

##### 3.2.2 Setting up for close limit position

To turn the manual-electric switch handle to the Manual-mode position; to turn the handwheel to make the valve fully-closed.

It’s the same as the above. To choose <close limit position> and then press “Yes” to go into calibration interface; press “Yes”, and “◆” begins to flash., press “Yes” to set up this position as the valve’s close limit position (Calibration could be made many times.) Last, press “No” to exit to where you want or, it will automatically exit from setting interface if there is not any operation in one minute.

Note: 1. Setting steps for operation button are the same as those above. Please refer to 1.3 Parameters Setup for button operation.

2. In order to remove gear clearance, valve fully-open position shall be got through turning the handwheel in the fully-closed direction at a time and avoiding turning the in the reverse direction.

3. If the system shows that “Position Setup Error” and refuse to exit from setting interface. At that time, user needs to reset open limit position and close limit position which should be confirmed in the allowable range. If user performs a forcible exit (cut off the power), the system will show “any operation is forbidden” and forbid to perform any electrical operation at the next startup. Reset effective open/close limit position until it can resume normal. If there is no problem with setup and “Position Setup Error” cannot be transformed, please contact the supplier.

### 3.2.3 Electrical verification

Set up valve’s open/close limit position before exit from the system. To turn the select button to “Local”, and then rotate the operation button to testify whether the valve could be operated to the open/close limit position. Repeat this step for several times until it meets the requirement.

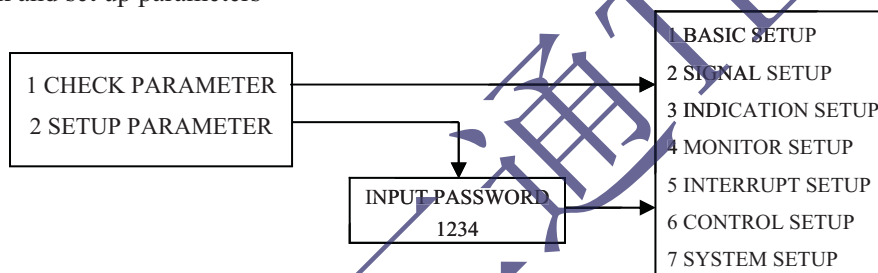
## 4. Setting for the actuator’s function and parameter

System parameters of actuators can be checked and set by operating the remote setter (for operating methods of remote setter and knobs, please refer to 1.2.2 and 1.3). To enter system setting turn the selection knob to STOP position first. Use the attached remote controller to handle the device, enter the interface of checking or setting system parameters. If there is no response after one minute, press the key on the remote controller again, the system will return to running state and display running interface.

Note: 1.All those with star mark (\*) in the diagrams are default parameters set upon delivery.

2.Some parameters could not be displayed due to different users’ orders.

### 4.1 Check and set up parameters



4.1.1 Check parameters: only for check when you go into Check Parameter. Modification is not allowed.

4.1.2 Setup parameter: only for modification when you go into Parameter Setup. It is need to input password before go into it. (Factory setting for the password is 1234 and the modified password should be saved properly. If it is lost, it cannot be reset or modified.)

### 4.2 Basic setup (see Fig.4)

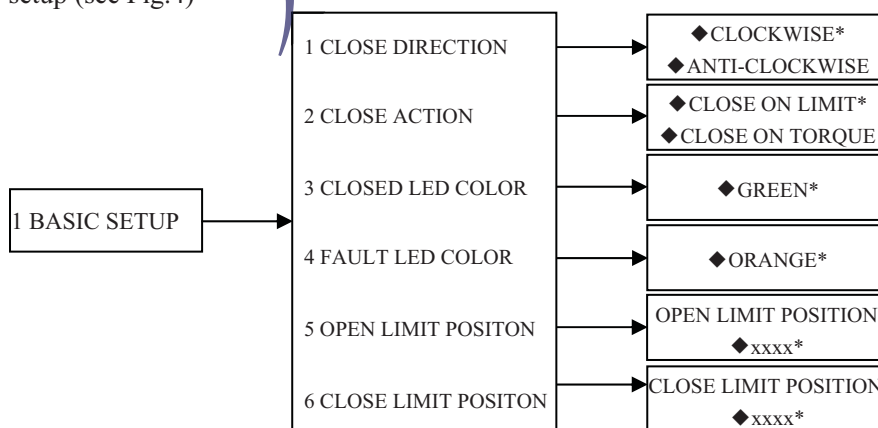


Fig.4

4.2.1 Close direction: The factory setting is clockwise closing valve, which should accord with that of the valve. If they do not match, you can make a change. When changing direction to close, be sure to change rotation mark for hand wheel.

4.2.2 Close action: user could set up close on limit method or close on torque methods. Factory setting of this is Close on limit. If the valve is closed by torque, the close torque should be first set. The open limit position should be set at this position at the same time.

4.2.3 Closed LED color: it cannot be set up. Factory setting of this is green.

4.2.4 Fault LED color: it cannot be set up. Factory setting of this is orange.

4.2.7 Open limit position: in the setting mode(former open/close limit position allows actuator to act), manually turn the valve to the user-required maximum opening position and press yes key to set this position as the valve open limit position. Factory setting of this is at will.

4.2.8 Close limit position: in the setting mode(former open/close limit position allows actuator to act), manually turn the valve to the user-required closing position and press yes key to set this position as the valve close limit position. Factory setting of this is at will. It cannot be transformed when it is resumed factory setting.

4.3 Signal setup (see Fig.5)

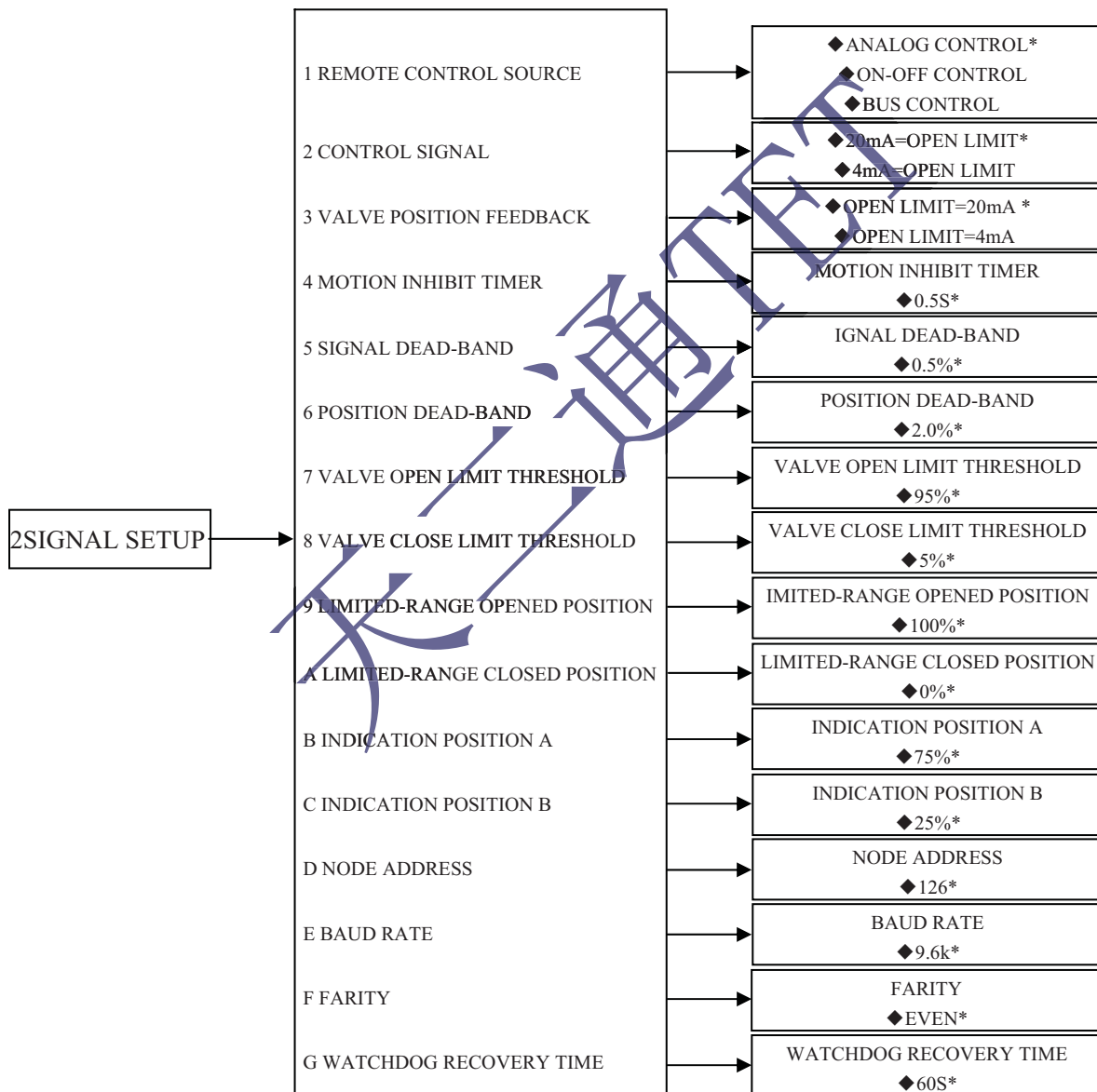


Fig.5

4.3.1 Remote control source: It is the working manner of remote control. The final control manner depends on wiring methods. The factory setting is analog control.

4.3.2 Control signal: For analog/positioning control low signal (4mA) is normally defined as close and high signal (20mA) as opening-valve. Or, adversely, low signal (4mA) is defined as opening-valve and high signal (20mA) as closing-valve. The factory setting is high to open.

4.3.3 Valve position feedback: If you select high to open limit, the output for open limit position is 20mA. If you select low to open limit, the output for open limit position is 4mA. Or, adversely, low signal (4mA) is defined as opening-valve and high signal (20mA) as closing-valve. The factory setting is high to open limit.

4.3.4 Motion inhibit timer (MIT): MIT is set to protect the actuator. A delay time set for limiting the times of motion of the motor, ranging from 0 to 25.5 seconds. The factory setting is 0.5s.

4.3.5 Signal dead-band: This is effective in the analog mode. To avoid actuator's too sensitive response to the change of analog signal, we define a definite range of analog signal, within which the actuator does not respond to it. The range is 0%-10% and the factory setting is 0.5%.

4.3.6 Position dead-band: This is effective in the analog mode. The range of error allowed by user is called positioning dead band, 0%-10%. The factory setting is 2%. Increasing the setting on an allowed basis will prolong the service life of the actuator and valve. (Normally, the above two dead bands superpose instead of composing. The signal dead band relates to signal interference (wave filtering), while positioning dead band relates to the precision of valve positioning including restraining vibration and fluid medium disturbance.)

4.3.7 Valve open limit threshold: Caused by control signal source, 100% signal could fall short of 20mA, say, only 95% or more, at this time, we could let the actuator to take it as 100% signal and actuate open limit position operation. The range of such a threshold is 90%-100% and the factory setting is 95%.

4.3.8 Valve close limit threshold: The reason for setting such threshold is the same as above.. The range of the threshold is 10%-0% and the factory setting is 5%.

4.3.9 Limited-range opened position: The signal for open limit position in limited range positioning control is set from 0% to 100% and factory setting is 100%.

4.3.10 Limited-range closed position: The signal for close limit position in limited range positioning control is set from 100% to 0% and factory setting is 0%.

Note: remote limited positioning: a range could be set as limited positioning during the whole control range (factory setting is 0%-100%). Actuator will calculate according to the limited positioning which is set up by user, which makes the valve's position to accord with 4-20mA. If the system presents valve open analog signal, the valve will actuate to the limited range opened position; on the contrary, if the system presents the valve closing analog signal, the valve will actuate to the limited range closed position. Remote on-off control and local control are not influenced by limited range positioning. The actuating range is influenced by valve open and valve close.

4.3.11 Indication position A: Valve position could be showed by the contacts on status relay RL1-RL8. If it is larger than this position A, then certain relay will be activated. A range of 0%-100%. The factory setting is larger than 75%. Users can set the position as required.

4.3.12 Indication position B: Valve position could be showed by the contacts on status relay RL1-RL8. If it is smaller than this position B, then certain relay will be activated. A range of 0%-100%. The factory setting is smaller than 25%. Users can set the position as required.

4.3.13 Node address: Node address. (Profibus) or address (Modbus) of the device. Range: 0-255. Factory setting: 50. Different range according to different field bus protocol.

4.3.14 Baud rate: Communication Baud rate for Modbus bus mode. Range: 300-57.6K. Factory setting: 9.6K.

4.3.15 Parity: Communication parity bit for Modbus bus mode. Range: ODD, EVEN and NONE. Factory setting: EVEN.

4.3.16 Watchdog recovery time: The watchdog recovery interval for the system in static state (no electric operation). If the parameter is set to 0 second there will be no watchdog recovery function. Range: 0-255 second. Factory setting: 60seconds.

4.4 Indication setup(see Fig.6, Applicable actions for status relay RL1-RL8 are in the following table)

The indication contacts 1~8 are contacts of RL1~RL8. Each indication contact can indicate one type of state only. To excite or not could be selected in setting menu of contact functions. The use method for the alternative RL5~RL8 is the same as that for RL1~RL4, users can select different contact functions according to their demands. The factory setting are: RL1: open limit→ activated; RL2: close limit→activated; RL3: over-torque→activated; RL4: remote selected→activated.

4.5 Monitoring setup (see Fig.7, Applicable actions for monitoring relay RL0 are in the following table)

Generally, that the monitor relay RLO is activated means the electric actuator is in service. The 8 monitoring states are in OR relationship. If one of them is effective, the monitor relay will be released. The monitoring states 1 and 2 had been set upon delivery and they can be modified by users. The monitoring states 3 to 8 can be set by users according to their demands. The factory settings are local stop and fault alarm state.

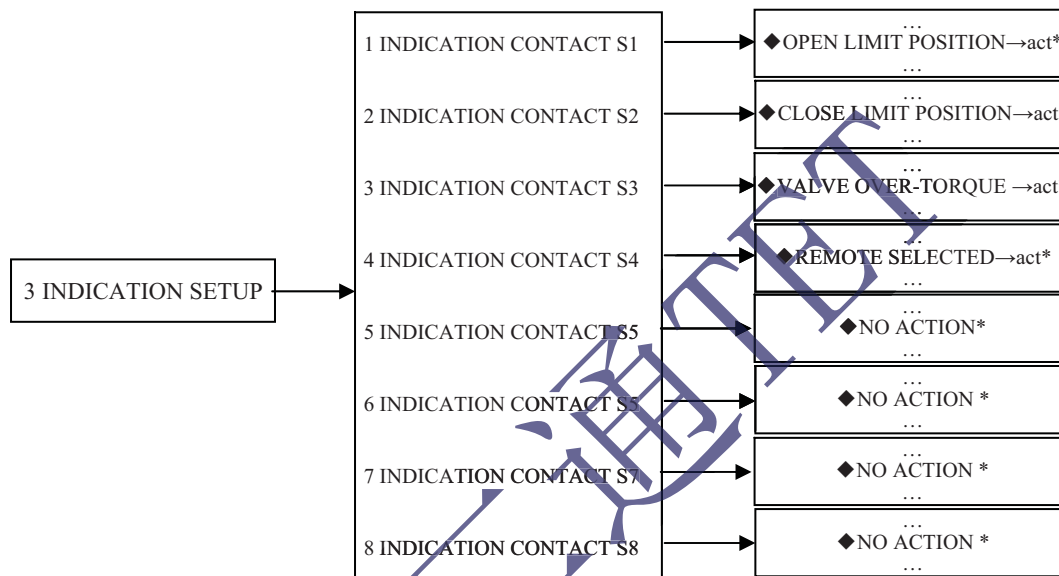


Fig.6

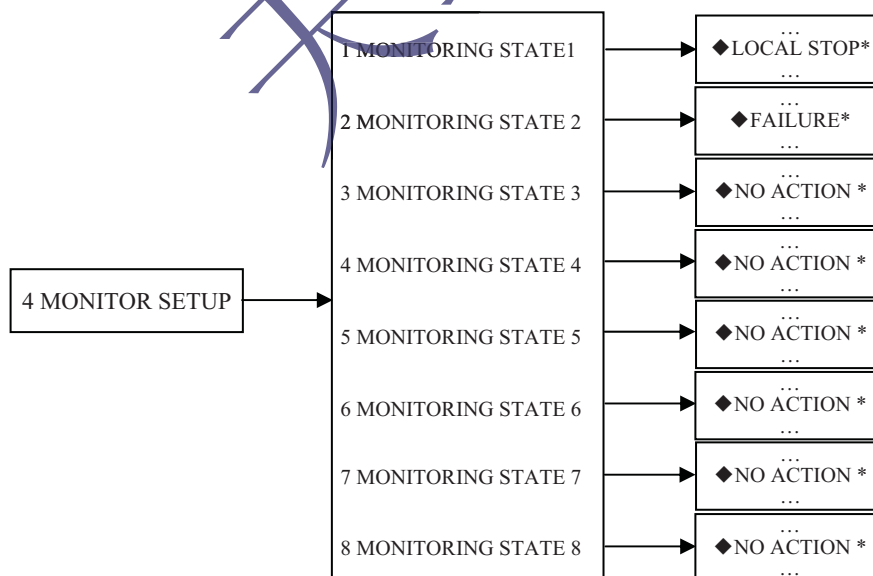


Fig.7

4.5.2 Applicable actions for monitoring relay RL0 are in the following table.

Statuses to be set for contacts of status indication relays RL1-RL8 and contacts of monitor relay RLO include:

(The relay will pick up when activated)

No.	State	Explanation
0	NO ACTION	
1	LOCAL SELECTED	Control manner of actuator (position of selection knob)
2	REMOTE SELECTED	
3	LOCAL STOP	
4	ESD ACTIVE	ESD active
5	ACTUATOR RUNNING	(6 or 7)
6	RUNNING OPEN	Actuator is moving to opening direction
7	RUNNING CLOSE	Actuator is moving to closing direction
8	MOVING BY HAND	above 2%
9	MOVING IN HIBITED	(10 or 11)
10	M.I.T	Motion inhibited timer enabled
11	INT.TIMER	Interrupter timer enabled
12	OPEN LIMIT POSITION	Open limit position of a valve. A logical limit position. It can be set by users themselves as required by valve.
13	CLOSE LIMIT POSITION	Close limit position of a valve. A logical limit position. It can be set by users themselves as required by valve.
14	LMT-RANGE OPENED	Open in limited range operation manner of a valve
15	LMT-RANGE CLOSED	Close in limited range operation manner of a valve
16	GREAT THAN POSITION A	The setting is enabled when the opening is greater than indication position A, which will be set by users according to checking position requirement.
17	LESS THAN POSITION B	The setting is enabled when the opening is smaller than indication position B, which will be set by users according to checking position requirement.
18	OPEN LIMIT SW REACHED	It is a physical limit position on which the open limit switch acts and no electric operation can exceed it.
19	CLOSE LIMIT SW REACHED	It is a physical limit position on which the close limit switch acts and no electric operation can exceed it.
20	MID-TRAVEL POSITION	Any position between open limit position and close limit positions for a valve
21	ALARM	Caution type failures (22-35). After this type of failure occurs the control signals can still control electric actuator's operation under certain condition.
22	CONTROL ALARM	Control signal alarm (23-26).
23	SIGNAL LOST	Loss state of remote 4-20mA positioning control signal or site bus control signal.
24	SIGNAL OVERRUN	To exceed certain range of control signal.
25	OPENNING OVERRUN	To exceed open limit position.(valve position $\geq$ 103%)
26	CLOSING OVERRUN	To exceed close limit position.(valve position $\leq$ -3%)
27	VALVE BLOCKED	(28 or 29)
28	OPENING BLOCKED	Jam state occurs in opening direction of a valve.
29	CLOSING BLOCKED	Jam state occurs in closing direction of a valve.
30	VALVE OVER-TORQUE	(31 or 32)
31	OPENING OVER-TORQUE	Over-torque state occurs in opening direction of a valve.
32	CLOSING OVER-TORQUE	Over-torque state occurs in closing direction of a valve.
33	MOTOR ALARM	(34 or 35)
34	MOTOR OVERHEAT	Motor temperature is too high and the switch trips off.
35	MOTOR OVERCURRENT	Range of allowable time for motor to exceed limit rated current.



36	FAILURES ALARM	Fatal failures (37-48). After this type of failure occurs, electric operation of an actuator is completely prohibited until the failure is removed or the device enters into setting mode or the valve opening/closing knob is turned to opening position for more than 15 seconds.
37	POWER FAILURES	(38 or 39)
38	POWER PHASE LOST	Power supply phase lost.
39	MOTOR PHASE LOST	Motor phase lost caused by motor winding failure or contactor failure.
40	ENCODER FAILURES	Encoder failure(41,42)
41	VALVE ENCODER FAILURE	Valve encoder failure
42	TOQUE ENCODER FAILURE	Torque encoder failure
43	MOTION FAILURES	(44 or 45)
44	MOTION OBSTRUCTED	A valve failed to reach objective position. Note: The reason for motion obstructed will decide the failure type (caution failure or fatal failure).
45	VALVE JAMMED	Valve Blocked occurs in both directions.
46	MODULE FAILURE	Malfunction in the motor control module
47	BUS FAILUREAL	Bus interface module failure
48	MAINBOARD	Communication malfunction in HMI and mainboard

4.6 Interrupter setup (see Fig.8)

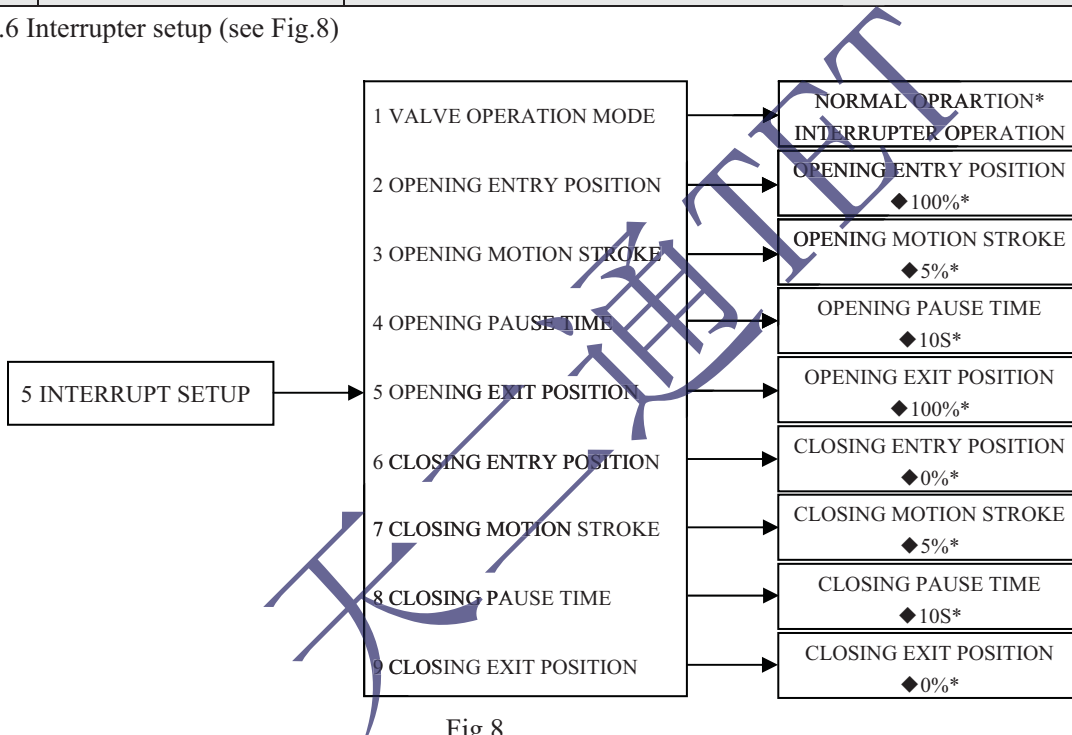


Fig.8

4.6.1 Valve operation mode: The factory setting is normal operation.

Normal operation: The action of electric actuator to drive valve is in the manner of continues motion.

Interrupter operation: To avoid water hammer or reduce the rate of pressure change in pipe, some applications require the device to slow down on its valve closing/opening operation. Actuator can perform interrupt motion during interrupter operation. This function is effective only in on-off control mode.

4.6.2 Opening entry position: When actuator works on interrupter operation manner, users need to set the start position of opening interrupter operation in the range of 0%~100%. The factory setting is 100%. (There will be no interrupter operation if 100% is set.)

4.6.3 Opening motion stroke: It is the stroke setting, in the range of 5%~100%, for each motion of the valve in opening direction when the actuator works on interrupter operation manner. The factory setting is 5%.

4.6.4 Opening pause time: It is the interval setting, in the range of 1~255 seconds, for each motion of the valve in opening direction when the actuator works on interrupter operation manner. The factory setting is 10 seconds.

4.6.5 Opening exit position: When actuator works on interrupter operation manner, users need to set the stop position of opening interrupter operation in the range of 0%~100%. The factory setting is 100%. (There will be no interrupter operation if the setting is <= the opening start position.)

4.6.6 Closing entry position: When actuator works on interrupter operation manner, users need to set the start position of closing interrupter operation in the range of 0%~100%. The factory setting is 0%. (There will be no interrupter operation if 0% is set.)

4.6.7 Closing motion stroke: It is the stroke setting, in the range of 5%~100%, for each motion of the valve in closing direction when the actuator works on interrupter operation manner. The factory setting is 5%.

4.6.8 Closing pause time: It is the interval setting, in the range of 1~255 seconds, for each motion of the valve in closing direction when the actuator works on interrupter operation manner. The factory setting is 10 seconds.

4.6.9 Closing exit position: When actuator works on interrupter operation manner, users need to set the stop position of closing interrupter operation in the range of 0%~100%. The factory setting is 0%. (There will be no interrupter operation if the setting is >= the closing start position.)

4.7 Control setup (see Fig.9)

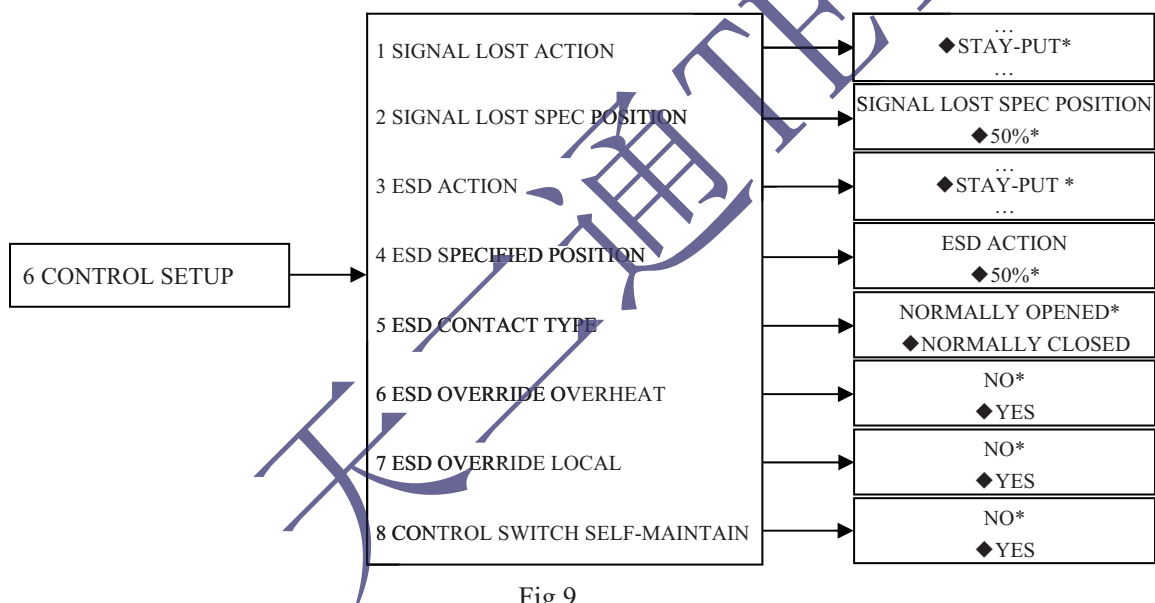


Fig.9

4.7.1 Signal lost action: During system operation positioning control analog signals or bus control signals might be lost, which is considered by the system as control signal lost and leads to an uncontrolled actuator. In order to ensure safety the system can instruct valve to stay put, or move to open, close or a specified position. The factory setting is to stay put.

4.7.2 Signal lost specified position: This setting is effective on control signal lost failure (4.7.1). When signal is lost, users can set the specified position of valve according to their needs in the stroke range of 0%~100%. The factory setting is 50%.

4.7.3 ESD action: This is a signal for emergency protection. When an emergency occurs, it can instruct the valve to move to open/close or a specified position. The factory setting is to stay put. ESD signal can override motor failures, such as overheating, over-torque and over-current etc. The operation manner and failures which the system can override can be set.

4.7.4 ESD specified position: this is only effective in 4.7.3. When ESD is effective, valve will actuate to this appointed position. User can set up the appointed position during the stroke 0%-100%. Factory setting:50%.

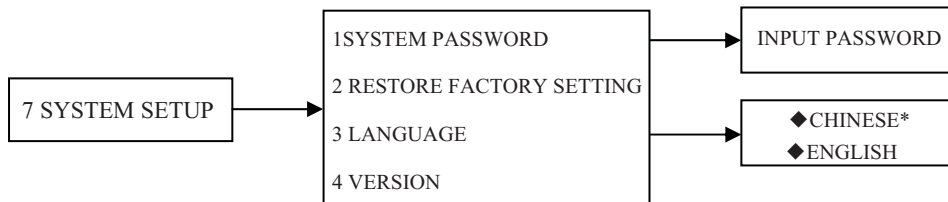
4.7.5 ESD contact type: The setting of contact state for emergency protection ESD. The factory setting is normally open. When the contact is closed, ESD becomes effective.

4.7.6 ESD override overheat: ESD can override overheating protection. The factory setting is ESD override overheat.

4.7.7 ESD override local: ESD can override local operation. The factory setting is ESD override local.

4.7.8 Control switch self-maintain: ESD can override interrupter operation. The factory setting is ESD override interrupter.

#### 4.8 System setup



4.8.1 System password: To enter into secondary setting needs to input password to avoid mishandling. The password set upon delivery is 1234. You should save the revised password properly. Otherwise, you will not be able to reset the system parameters if you have lost the password.

4.8.2 Restore factory setting: Each item of setting has its factory default. When users need to change the purpose of actuator or reset system parameters, they can select *restore factory setting*.

If maintenance is required, open limit position and close limit position should be reset after or before mounting to the valve.

Note: The function *restore factory setting* should be used with extreme caution! After performing *restore factory setting* all parameters set by a user will be replaced by factory setting and many parameters including valve open and close limit position need to be reset. After users reset various parameters they should keep the relevant records properly.

4.8.3 Language: Select Chinese or English for display language you desired.

4.8.4 Version: The version number is displayed on the start-up interface. See the Instruction for Display.

### 5. Wiring methods (Make the schematic diagram of IQT-01 as an example)

<p>Common terminal Selection of remote positioning control (RPC) or field bus control Selection of remote ON-OFF control or STOP Opening- valve (OPEN) Closing- valve (CLOSE) ESD input</p>	<p>Standard: remote positioning/switching value methods</p>
<p>Manner of on-off control Under on-off operation manner, you can select self-locking or non self-locking mode. On non self-locking mode the system operates with the OPEN and CLOSE contacts closed. On self- locking mode the actuator will get self- locking after the OPEN or CLOSE contact is closed and run to open limit position or close limit position in a specified direction unless an adverse switch is closed and, at this time, the actuator will stop running and then it will get self- locking and</p>	<p>Self-locking                  non-self-locking</p> <p>When actuator is running under the self-locking mode, should an</p>

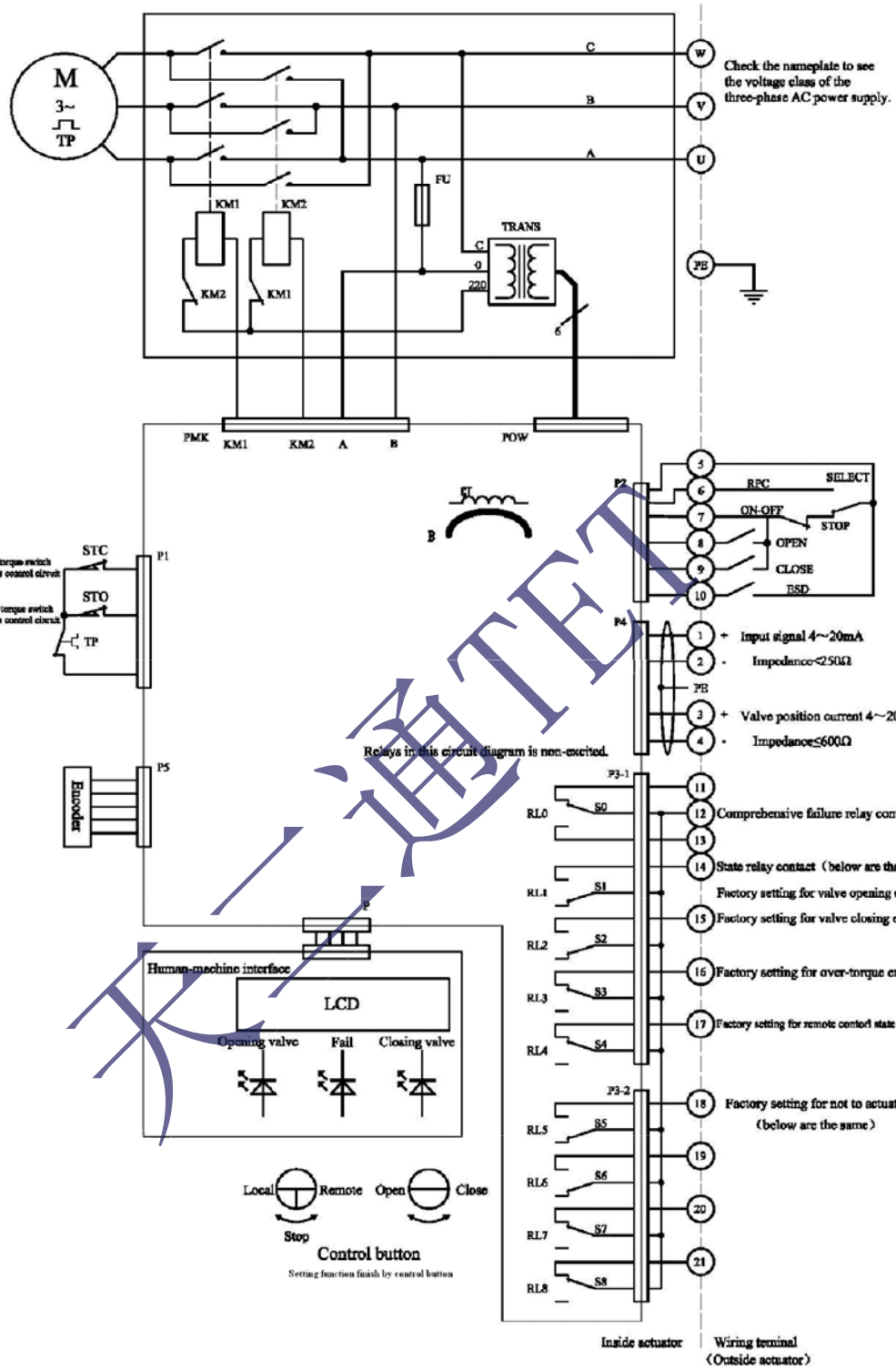
<p>run according to a new on-off instruction.</p>	<p>adverse switch is closed, the actuator will stop running and then it will get self- locking and run according to a new on-off instruction.</p>
<p>Manner of on-off control Under on-off operation manner, open/close is in priority service</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Close priority</p> </div> <div style="text-align: center;"> <p>open priority</p> </div> </div>
<p>Outside supply DC 24V</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Self-locking</p> </div> <div style="text-align: center;"> <p>non-self-locking</p> </div> </div> <p>When actuator is running under the self-locking mode, should an adverse switch is closed, the actuator will stop running and then it will get self- locking and run according to a new on-off instruction.</p>

Note:

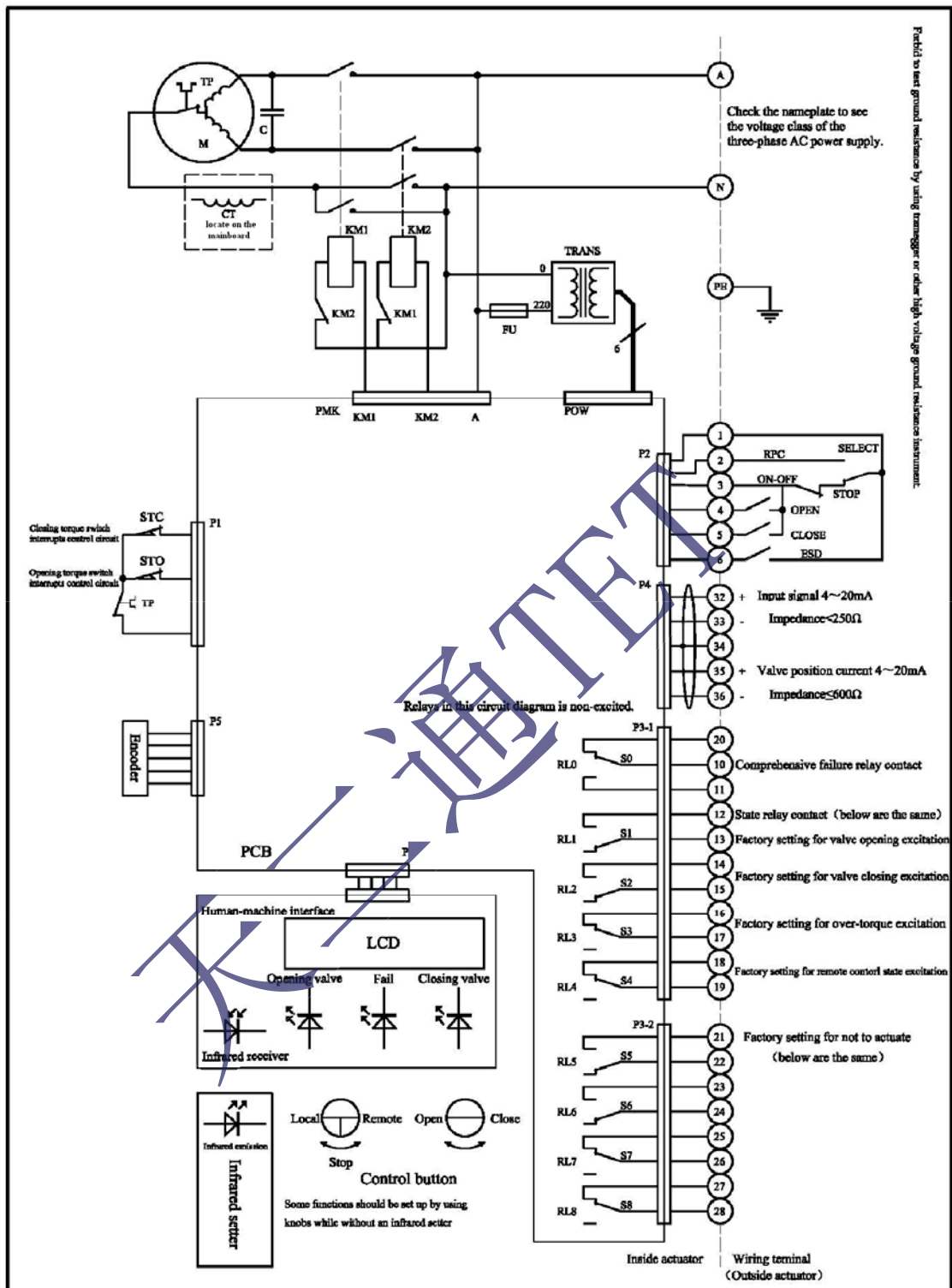
1. Remote positioning control could be in the manner of remote current 4~20mA positioning or via site bus control.
2. If remote positioning control is not used, SELECT could be set to short circuit and terminal ② set to open circuit.



Forbidden to test ground resistance by using megger or other high voltage ground resistance instrument.

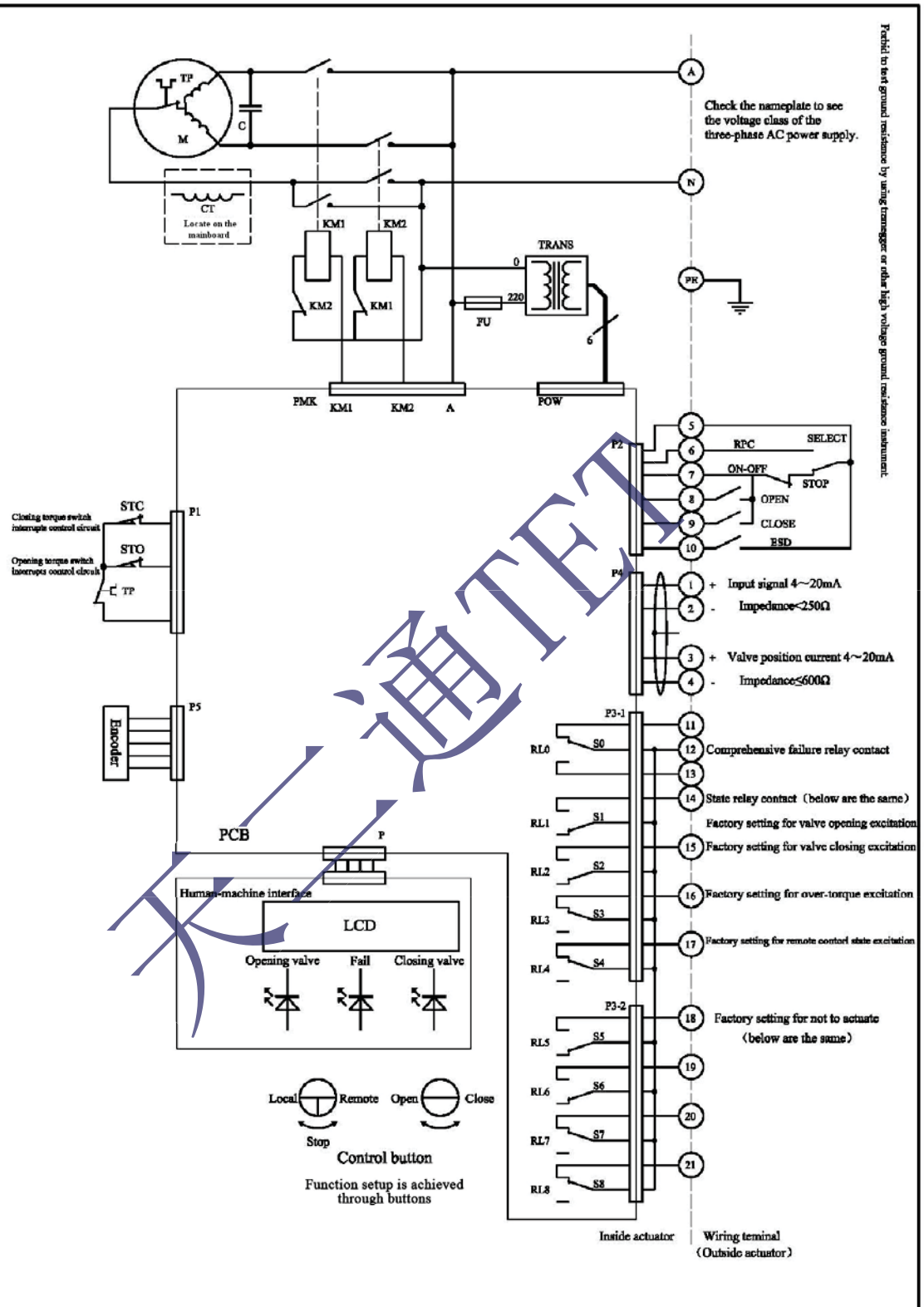


Contract No.		Drawing No.	IQT-01Ex
Item	Schematic Diagram of IQT Series Valve Electric Actuator		Applied to intelligent, explosion-proof type with three-phase
			TIANJIN BAILIERTONG MACHINERY CO., LTD.



Contract No.		Drawing No.	IQT-02
Item	Schematic Diagram of IQT Series Valve Electric Actuator		Applied to intelligent type with single phase
			TIANJIN BAILIERTONG MACHINERY CO., LTD.

Prohibit to test ground resistance by using transformer or other high voltage ground resistance instrument.



Contract No.		Drawing No.	IQT-02Ex
Item	Schematic Diagram of IQT Series Valve Electric Actuator		Applied to intelligent type with single phase
			TIANJIN BAILIERTONG MACHINERY CO., LTD.



## Part III Additional Information for IQT Explosion-proof Type of Intelligent Electric Valve Actuator

### 1. Summary

IQTEx series explosion-proof type is produced on the basis of GB/T 3836.1 《General Requirement for the Equipment Used in Explosive Environment, Part I》 and GB/T 3836.2 《The Equipment Protected by Explosion-proof Enclosure “d” Used in Explosive Environment, Part II》. Meanwhile, this series have been tested, experimented and finally verified by the national verified explosion-proof organization and get Conformity Certificate of Explosion-Proof.

The explosion-proof grade of IQT1-4 explosion-proof type is Ex db IIB T6 Gb. The sign “Ex” shows that the electric apparatus comply with the Explosion-proof Standard; “db” shows that the explosion-proof type is enclosure explosion-proof; II class represents that electric apparatus used in explosive gas environment except for gas made from coal; IIB represents that the gas is ethylene; T4 indicates that the permissible surface temperature is 85℃; Gb is apparatus protection degree.

The explosion-proof grade of IQT5-7 explosion-proof type is Ex db IIB T4 Gb. The sign “Ex” shows that the electric apparatus comply with the Explosion-proof Standard; “db” shows that the explosion-proof type is enclosure explosion-proof; II class represents that electric apparatus used in explosive gas environment except for gas made from coal; IIB represents that the gas is ethylene; T4 indicates that the permissible surface temperature is 135℃; Gb is apparatus protection degree.

Product seating No. Includes: IQT1Ex, IQT2Ex, IQT3Ex, IQT4Ex, IQT5Ex, IQT6Ex, IQT7Ex.

### 2. Notes for usage

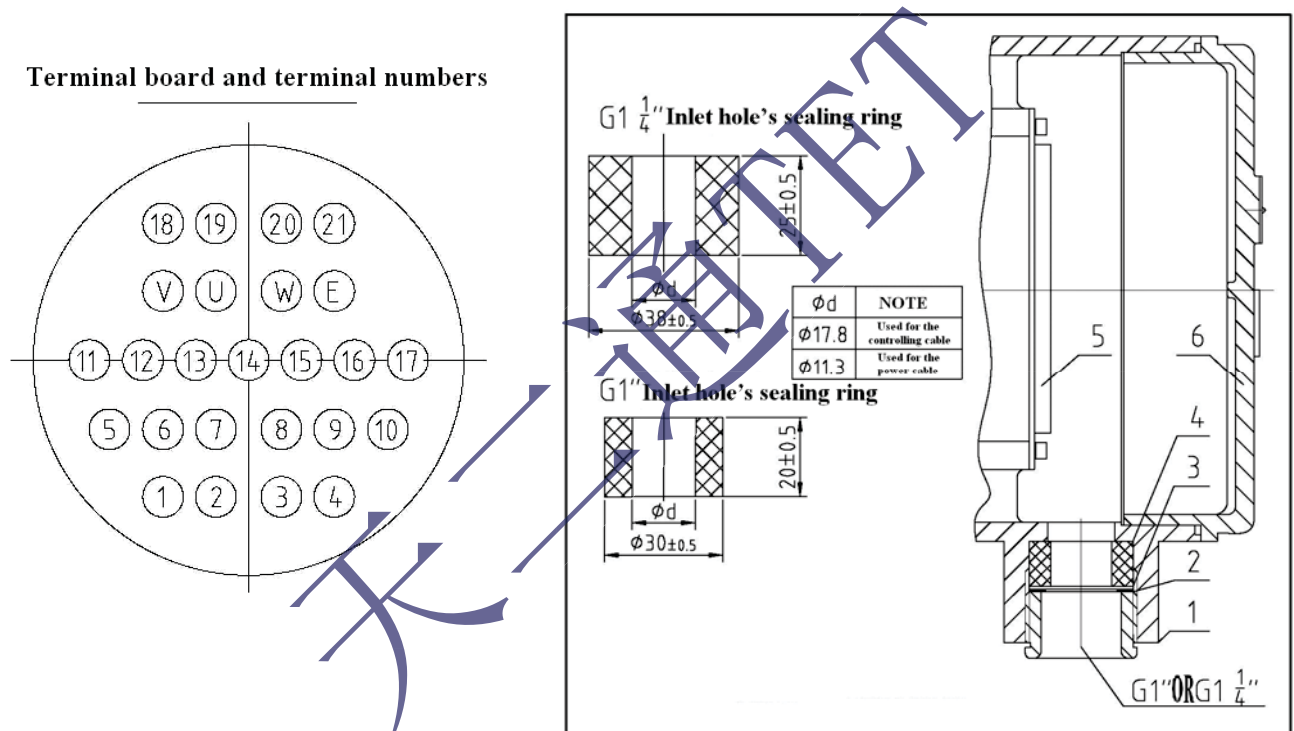
- 2.1 Power must be cut off when actuator's any cover is open. (Please see the warning plate: “Forbid to open the box cover when the power is on.”)
- 2.2 Don't hit the openness window glass and glass crack is forbidden.
- 2.3 Keep the nameplate and warning plate being fixed on actuator and the words on them should be recognized.
- 2.4 Don't open the electric box cover outdoors in rainy day or windy day.
- 2.5 The product's explosion-proof cover cannot be knocked or scratched during maintenance or debugging.
- 2.6 Apply anti-rust painting 204-1 after debugging or maintenance and before assembling.
- 2.7 Please notify the company to change the broken explosion-proof elements. The products cannot be powered on until it is renewed with qualified element.
- 2.8 Fasten the screws on the control box cover and wiring box cover after product debugging. After some strong vibration, please make regular check to make sure whether it is reliable.
- 2.9 Keep o-ring safely, and change a new one after it is damaged
- 2.10 External ground wiring should be reliable.
- 2.11 While connecting wires, it should be strictly comply with Explosion-proof type drawing. The joint head cannot be exposed and become flexible so as to ensure an appropriate creep age and leakage distance. Cable inlet shall be with sealing stuffing box.

### 3. Electrical wiring

There are three inlet ports on the wiring case and they are two G1” and one G1<sup>1</sup>/<sub>4</sub>”. Make G1” inlet ports as an example, wiring steps are the followings:

- 3.1 Remove No.1 Gland Nut, and take No.2, No.3 and No.4. In this case, No.3 gasket which is used for sealing is useless.
- 3.2 Open No.6 wiring case

- 3.3 Put power cable and controlling cable through into No.1, No.2 and No.4 (No.2 sealing rubber plug is shown in the drawing.)
- 3.4 Put the cable through into the inlet port of the wiring box, and connect every core wire with lug plate firmly.
- 3.5 Connect each core wire with the corresponding terminal numbers on the terminal board according to Electric Schematic Diagram.
- 3.6 Pull every component which are on the cable into the wiring box's inlet hole; then gently pull cable outward. Make sure cable's rubber jacket is in sealing plug.
- 3.7 Screw the gland nut firmly so as to make the sealing plug be compressed is firmly connected with cable rubber jacket.
- 3.8 Make sure O-ring and the port are clean before mounting the wiring box cover. Should screw its screw to make sure sealing performance.
- 3.9 Connect the electric actuator's external ground, which should be safe and sound.



#### 4.Others

- 4.1 Go for debugging according to Part II after wiring connection.
- 4.2 Due to the several times of mounting and dismantling, sealing plug could be damaged. If so, user can purchase from the manufacturer.
- 4.3 G1" and G1 1/4" conduit could be applied to displace gland nut's inlet wire.

## Special Cautions

In order to ensure the protective performance of the case of the whole electric actuator, users must strictly follow the requirements in the *Operation Manual* and in this *Special Cautions* while performing relevant operations when they set and service the actuators. If users failed to follow the regulations in the *Operation Manual* and the *Special Cautions* while performing relevant operation and have resulted in fail-safe protection of the case of the electric actuators, the users shall bear the responsibility.

Before delivery all locations related to case protection of the products have been strictly inspected to ensure that the case is airtight. If users need to open the following locations for setting, service or any other reasons:

1. Case of control box
2. Case of connection box
3. At places where wire comes in and goes out, it must be ensured that

User must ensure the following points after open the case:

1. There is no affect of adverse elements such as rain, snow, hail, damp and dust, etc. as the electric actuator will lose original protection function in the above conditions.
2. At the end of operation, replace the cover. When fastening the clamp nuts at wire inlet and outlet, make sure that no adverse elements (such as severe damp, water and dust, etc.) that could weaken protective performance left in the inner space.
3. After usage, make sure that rubber seal rings are not damaged and fasteners are securely screwed down without any omission. At the same time, user should make sure the o-ring between the case and bodies is out of damage and then, apply calcium grease
4. Select a proper cable outlet application according to the dimensions of cable and thread holes. Make sure the cable with thread is firmly mounted and sealed in order to make sure the product's protection degree.
5. Other parts, say, openness window, switch hand and handwheel are reset due to some reason. The user should make sure that they do not make any bad effect on.

### **Tianjin Baili Ertong Machinery Co., Ltd.**

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**Our Company reserves the right to amend this operation manual.**