

## AIJK Series SCR/Thyristor Phase-Shifting or Zero Crossing Firing Module Operation Instructions



### 1. MAIN FEATURES

Applying single-chip technology, AIJK series intelligent SCR/Thyristor Phase-Shifting or Zero-crossing Firing Module are powerful and reliable. They are suitable for various industrial furnaces of resistance wires, silicon carbide heating elements, MoSi<sub>2</sub> heating elements, and tungsten filaments, and can also control soft-start of electromotor. The main features include:

- 0-20mA (0-5V) / 4-20mA (1-5V) signal inputs selectable.
- Linearizing power adjusted by computer technology. When the load is resistive, its output power is proportional to input signal.
- Phase failure and over-shoot checking and alarming. In addition, AIJK3 can check thyristor shoot-through and load open circuit.
- Automatic synchronization. Not necessary to check the sequence of thyristor trigger wires. For AIJK3, even the electric polarity is no need to check.
- Application of complete electric isolation and “burnt-proof” technology. It is very reliable, and has a little interference to input terminals.
- Soft-start / soft-stop function with current feedback and adjustable delay time. Suitable for MoSi<sub>2</sub> heating elements, tungsten filaments, electromotors, and inductive loads.
- Equipped with on-off power, which be directly supplied by 220VAC power, and can provide two groups of 5VDC and 24V DC outputs.

**2. MODEL COMPARISON**

	<b>AIJK3</b>	<b>AIJK6</b>
<b>Load</b>	Resistive	Resistance / Inductance load
<b>Wiring</b>	three-phase four-wire / two-phase / single-phase	three-phase three- wire
<b>Failure check and alarm</b>	Power phase failure, over-shoot, thyristor shoot through and load open circuit	power phase failure and over-shoot

**3. FUNCTION SELECTION**

After opening the front cover of AIJK, a 6-bit DIP switch is available for function selection.

Bit	Type	Description
1	Input Specification	OFF: 0~20mA or 0~5V ON: 4~20mA or 1~5V Voltage or current can be selected by jumper. 0~10mA: select 0-5V input and then parallel connect a 500 ohm resistor. 0~20mA: recommended in order to get better anti-interference and resolution.
2	Wiring	OFF: three-phase four-wire, only for AIJK3 ON: three-phase three-wire, only for AIJK6 It is correctly set in manufacturer.
3	Trigger mode	OFF: Phase-shifting trigger ON: Zero-crossing trigger
4	Phase failure alarm	OFF: alarm when any phase fails or thyristor is shot through among the three phases. ON: alarm when more than one phase is failed. Suitable for two-phase trigger. For single-phase trigger, to avoid mistake alarm, serial connect a 500Kohm resistor to 220VAC power to simulate an input signal.
5	IN2 function selection	OFF: IN2 is connected to a resistor to set the delay time of soft-start/soft-stop. The time can be set to 1~41seconds. ON: The delay time of soft-start/soft-stop is fixed at 2 seconds. IN2 input current feedback. Alarm turns on when the current is 15% greater than the range.
6	Spare	Spare for special function. Please set it to OFF.

There are two jumpers on the board by which IN1 and IN2 can respectively select voltage input or current input.

**4. APPLICATION**

*4.1 Indication of run and alarm*

There are two indication lights “RUN” and “ALM” on the shell. The flashing of RUN light means that normal power signal is detected, and trigger signals are outputted. The ALM light on means failure is detected, and the relay for alarming is closed.

*4.2 Soft-start / soft-stop function*

AIJK has the function of soft-start / soft-stop which can decrease the shock to load and is suitable for inductive loads with transformer, such as tungsten filaments, MoSi2 and graphite heating elements. The delay time of soft-start / soft-stop, which means the time that output increases from 0 to 100%, can be

adjusted by connecting a resistor to IN2. Note that for furnace control, if the delay time is too long, the reaction will be slow and will affect the control effect. Increase of every 125mV voltage to IN2 terminal causes increase of 1 second. When the jump wire of IN2 is set to mA input and the input resistor is 250 ohm, a 1/4W resistor can be connected to terminals 12 and 13 to adjust the time constant. Some examples are as below:

DIP bit 5	Resistance	Voltage to IN2	Soft-start / soft-stop time (seconds)
ON	N/A	Current feedback	2 Sec (Suitable for resistive)
OFF	Open circuit	0	1 Sec (suitable for common resistive load)
OFF	4.75K	250mV	3 Sec
OFF	2.25K	500mV	5 Sec
OFF	1K	1V	9 Sec (suitable for soft-start of electromotor)
OFF	short circuit	5V	41 Sec

#### 4.3 Current feedback limit and over-shoot alarm

When DIP bit 5 is set to ON, current feedback can be input from IN2, and the time delay of soft-start / soft-stop is fixed at 2 seconds. The current of load can be retransmitted to 0~20mA current signal by an external retransmitter, and input to IN2. AIJK can provide 24V/25mA power supply for the retransmitter. This function can be used for soft-start of electromotor, or improve the control effect of the loads (like MoSi2, graphite and silicon carbide heating elements) whose resistance increases with temperature or aging. The reaction time of the retransmitter is about 20~40mS, the feedback signal should be stable and interference free, and the wire should be shielded. When the feedback current is 15% greater than the range (input voltage is about 5.75V), the relay for alarm will turn on. The rated retransmission current of the retransmitter is better to be the maximum allowed current of the load, for example, if the maximum allowed current of the load is 100A, then transmit 0~100A to 0~20mA. The current feedback applies proportional integral adjustment algorithm with fixed parameters. When the proportion is too big, it may cause some fluctuation of output current.

#### 4.4 Checking an alarming of phase failure, thyristor shoot through and open circuit of load

AIJK firing module has the function of checking power phase failure. In addition, AIJK3 can detect thyristor shoot through and open circuit of load. The alarm can be output to relay by which a sound or light alarm can be triggered and the power of load can be cut. The open circuit of load can only be detected when the load circuit is completely open. For example, if the load circuit is open, but there is other circuit parallel connect to the load, then the open circuit of the load cannot be detected. Therefore, if detection of open circuit is needed, then no other circuit should be parallel to the load.

#### 4.5 Linearized power output

AIJK series triggers are equipped with advanced linearized power output function. The common phase-shifting fires proportionate phase shifting angle to the input signal, but the output power is not proportional to the input signal since the power supply is a sine wave. AIJK firing module applies intelligence technology. Thus by non-linear compensation, it can output power proportional to the input signal, and improve the control quality of the furnace.

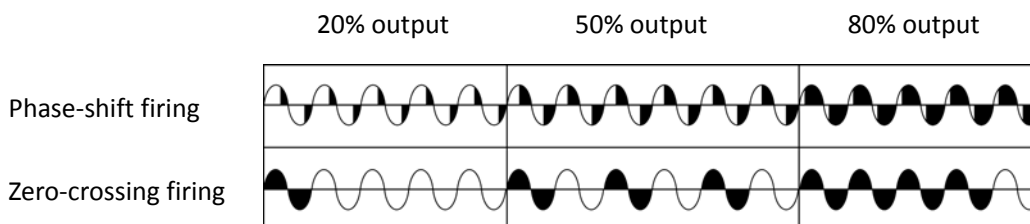
#### 4.6 Three-phase four-wire wiring and how to correctly choose the neutral wire.

If the load is a furnace and the load on the three phases is different (for example, silicon carbide heating elements), three-phase four-wire wiring can balance better than three-phase three-wire wiring. In addition, the open circuit failure of any phase in a three-phase four-wire system can be detected and alarmed by AIJK3. However, user must pay attention to choosing a suitable neutral wire. In common applications, if the loads of the three phases are the same, the current passing the neutral wire will be 0. So normally, the zero wire is much thinner than the phase wire. For common resistance load, the neutral wire should be as thick as the phase wire. For the load whose resistance changes with temperature or aging, for example, silicon carbide furnace, since it often works at small phase-shifting angle, the neutral wire should be thicker than phase wire, and is better to be the 2 to 3 times of the phase wire. To protect the neutral wire and also to avoid waste too much electricity on neutral wire, not the only the neutral wire from cabinet to furnace but also that from cabinet to power supply should be thick enough.

#### 4.7 Compatibility with AI- instruments

When AIJK firing modules is used with AI- instrument, it is recommend to use 0~20mA input, and set the parameters of the instrument as oP1 (or oPt)=2, oPL=0, oPH<=100. "oPH" is the upper limit of output. For high temperature furnace (for example, MiSo2 heating elements), it is better to use power limiting function. Generally, the output period Ctl should be greater than the time of soft-start / soft-stop.

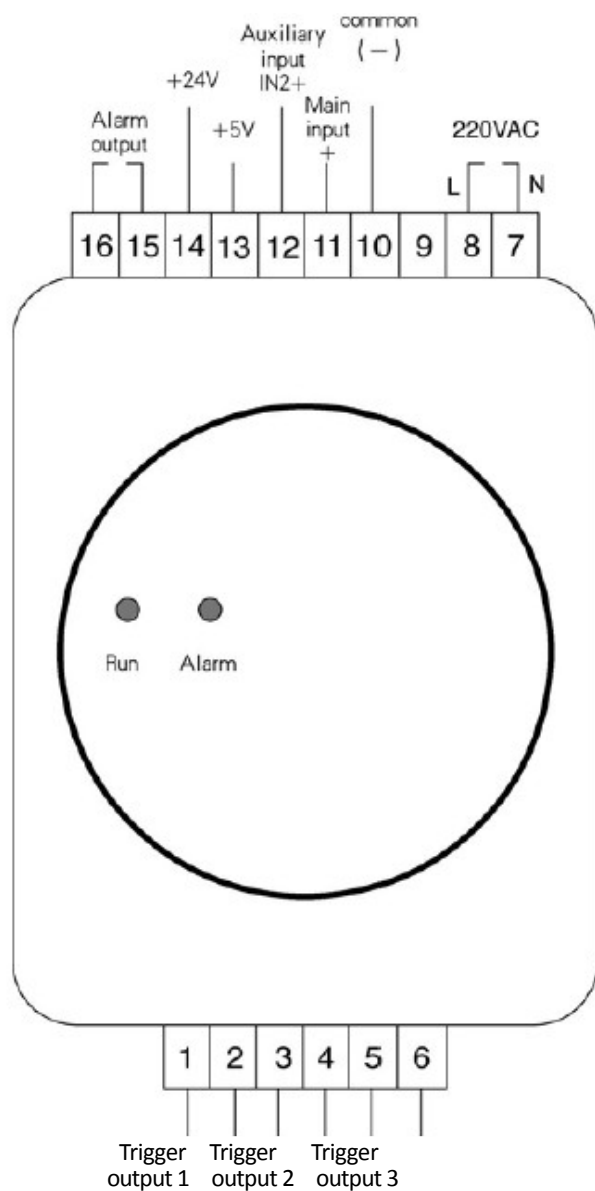
#### 4.8 Difference between phase-shifting and zero-crossing firing



\* The shaded area is the load current

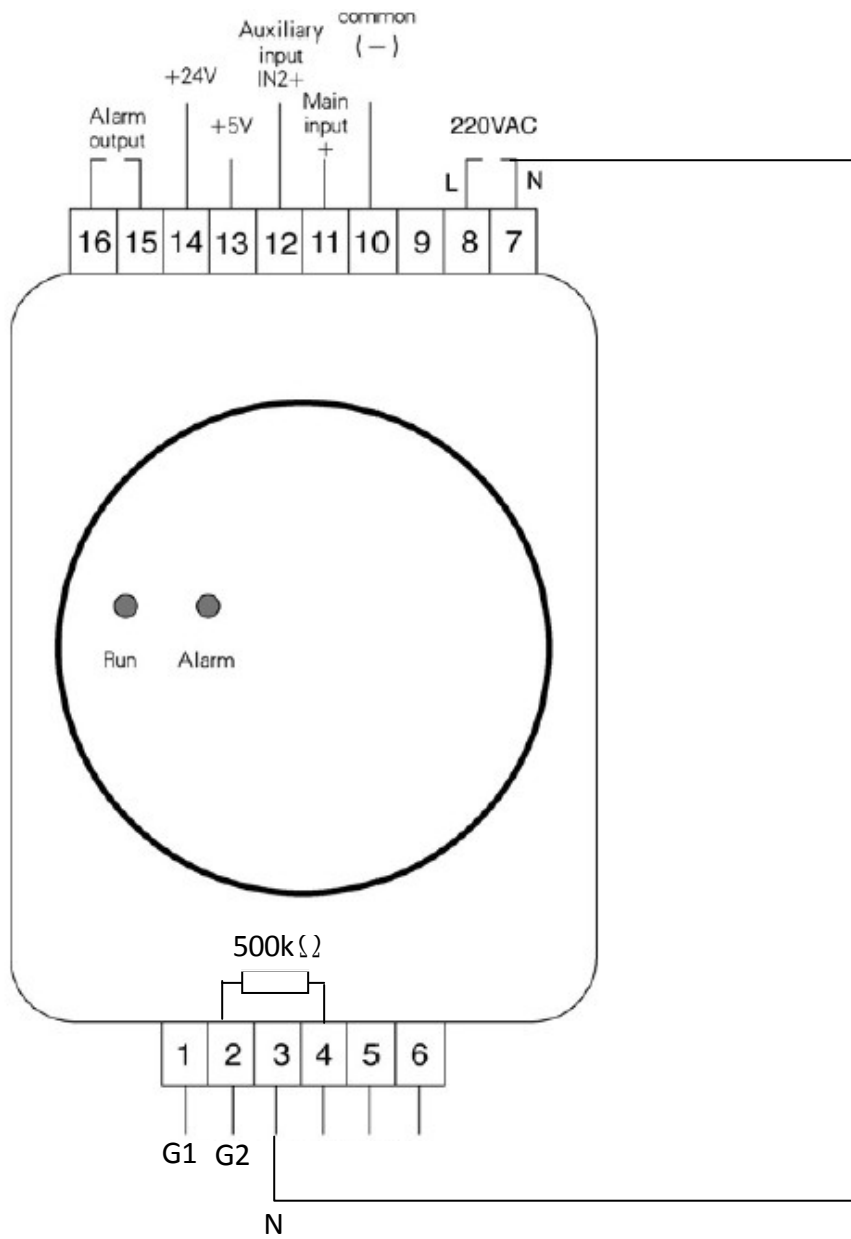
## 5. WIRING DIAGRAM

### 5.1 Wiring terminals

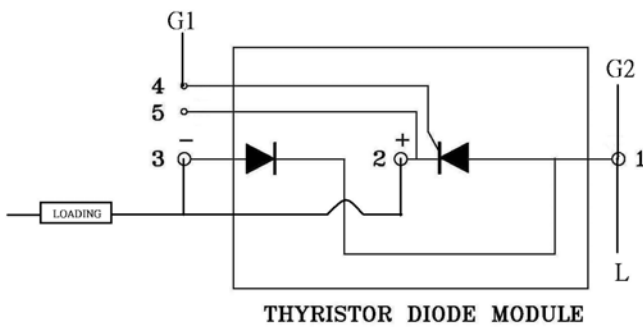


Note: The trigger output G1, G2, and terminals 7, 8 of AIJK6 are directional. Be aware not to connect in wrong direction.

For single-phase firing (DIP jumper bit-4 is ON, AIJK3 ONLY)

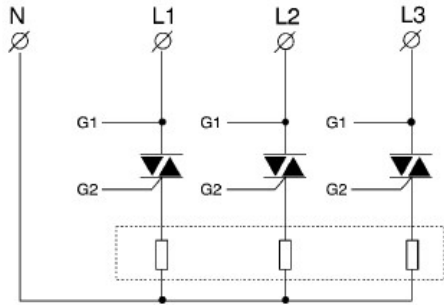


For Thyristor-Diode module and its connection with AIJK6

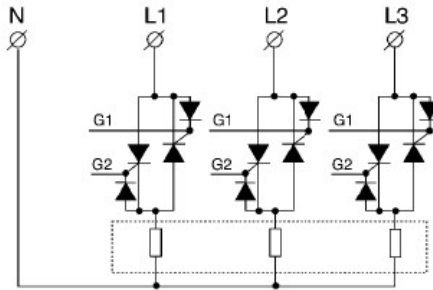


### 5.2 Thyristor firing output

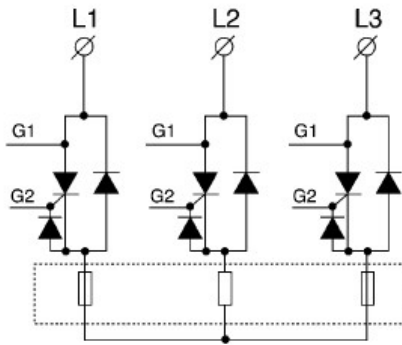
AIJK has 3 loops of firing outputs. AIJK3 is allowed to use either 1 loop or 2 loops of firing outputs. The wiring graphs are as below:



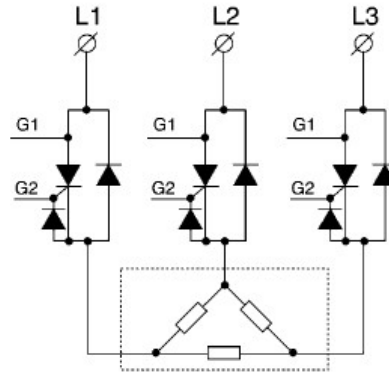
Star structure of three-phase four-wire (TRIAC circuit, only for current below 300A)



Star structure of three-phase four-wire (SCR reverse parallel circuit, it is recommended to use MCC series power modules)



Star structure of three-phase three-wire (SCR + Diode circuit, it is recommended to use MCD series power modules)



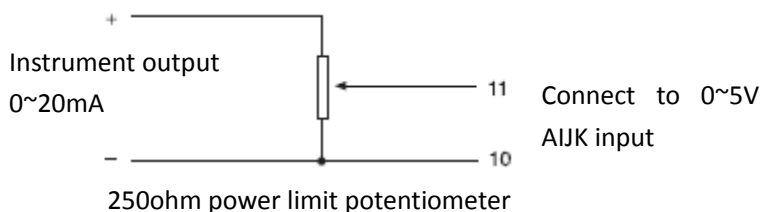
Triangle structure of three-phase three-wire (SCR + Diode circuit, it is recommended to use MCD series power modules)

### 5.3 High frequency interference

Phase-shifting firing will bring a quite strong 1~100Hz interference, so phase-shifting firing module should be installed close to thyristor, but should keep certain distance from the power line. The firing wire should be as short as possible and not parallel placed to firing wires of different phases.

### 5.4 Manually limit power

Besides current feedback, the output power can be also limited manually by connecting a potentiometer between AIJK and the instrument. For example, for the high temperature furnace of MoSi<sub>2</sub> or silicon carbide heating elements with resistance of the potentiometer is 250 ohms, the power should be greater than 1/2W. The instrument outputs 0~20mA while AIJK takes 0~5V input. The wiring graph is as below:



### *5.5 Manually adjust power*

Making use of the 5V voltage output of AIJK and connecting a 1K potentiometer to terminals 10, 11, 13 can also manually adjust power. DIP switch should be set to 0~5V input (bit 1 is set to OFF), and add a switch can implement auto/manual switch.