AIJK Series 3-Phase Phase-Shifting Thyristor Power Trigger

Operation Instructions

1. MAIN FEATURES

Applying single-chip technology, AIJK series intelligent 3-phase phase-shifting thyristor triggers are powerful and highly reliable. They are suitable for various industrial furnaces of resistance wires, silicon carbide heating elements, MoSi2 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.
- Triggering phase shift adjustment possible. By connecting E8 keypad, parameters of phase shifting can be adjusted regarding to single phase, two phases or whole triggering. Magnitude of signal and maximum limit of output can be adjusted.
- Soft-start function with adjustable delay time. Suitable for MoSi2 heating elements, tungsten filaments, motors and inductive loads.
- Missing Phase detection and alarm function
- Application of complete optical isolation and "burnt-proof" technology. It is very reliable, and has a little interference to input terminals.
- Built with switching power therefore direct 220VAC power is used. AI-JK30 / AI-JK33 provide two groups of 5VDC and 24VDC outputs.

2. MODEL COMPARISON

MODEL	Type of load	Wring Method	Alarm function
AI-JK10	Resistive and inductive	Single phase 220V/380V	
AI-JK30	Resistive	3-phase 4-wire, 2-phase and single phase	Phase missing detection
AI-JK30-J	Resistive	3-phase 4-wire, 2-phase and single phase	
AI-JK33	Resistive and inductive	3-phase 3-wire(Semi-control and full-control loop)	Phase missing detection
AI-JK33-J	Resistive and inductive	3-phase 3-wire(Semi-control and full-control loop)	

Remark: AI-JK30-J and AI-JK33-J are designed on the basis of AI-JK30, AI-JK33 without 24VDC voltage output and alarm output.

3. PARAMETER CONFIGURATION

Parameters are configured by external E8 keypad.

Press and hold (↻) for 2 seconds will access the customized Field Parameter Table. Press (◁) , (▽) or (△) to modify a parameter value. Press (▽) key to decrease the value. Press (△) key to increase the value. The decimal dot of the editing value blinks as if a cursor. Press and hold (▽) or (△) button will rapidly decrease or increase the value. The speed of change will further speed up when the cursor moving to the right. Press (◁) key to move to the desired position is also possible. Press (↻) to save the current parameter value and jump to next parameter. Press and hold (↻) will go down the parameter table rapidly. Press and hold (◁) for 2 seconds to return to the preceding parameter. Press (◁) (without release) and press (↻) simultaneously to quit the parameter configuration. The display will also automatically quit parameter configuration if no key is pressed within 25 seconds.

Set LOC parameter as "808". Press (↻) to enter the secondary menu for parameters below.

Code Shown	Parameter	Description	Range
L1C (AIJK30 only)	Trigger 1 Phase Shift Adjustment	L1C adjusts the phase shift on "Trigger 1" to compensate the magnitude of the corresponding phase output voltage, so that the control output tends to the three-phase equilibrium state. For example, setting L1C=-100 will lower the phase output voltage than that when L1C=0. Note: Generally, it should be set to 0. Incorrect setting will cause uneven three-phase output. L2C adjusts the phase shift on "Trigger 2" to compensate the magnitude of the corresponding phase output voltage, so that the control output tends to the three-phase equilibrium state. For example, setting L2C=100 will increase the phase output voltage than that when L2C=0. Note: Generally, it should be set to 0. Incorrect setting will cause uneven three-phase output.	-100 ~ +100
L2C (AIJK33 only)	Trigger 2 Phase Shift Adjustment	L2C adjusts the phase shift on "Trigger 2" to compensate the magnitude of the corresponding phase output voltage, so that the control output tends to the three-phase equilibrium state. For example, setting L2C=100 will increase the phase output voltage than that when L2C=0. Note: Generally, it should be set to 0. Incorrect setting will cause uneven three-phase output.	-100 ~ +100
L3C	Trigger 3 Phase Shift Adjustment	L3C adjusts the phase shift on "Trigger 3" to compensate the magnitude of the corresponding phase output voltage, so that the control output tends to the three-phase equilibrium state. For example, setting L3C=100 will increase the phase output voltage than that when L3C=0. Note: Generally, it should be set to 0. Incorrect setting will cause uneven three-phase output.	-100 ~ +100
LAC	Overall trigger phase	LAC is used for overall 3-phase shift adjustment in 3-phase triggering application. Setting LAC=-250 will lower the 3-phase output voltage than that when LAC=0.	-250 ~ +250
INP	shift adjustment	Input signal selection. 0-20mA / 4-20mA or 0-5V / 1-5V (Current or voltage input are defined by jumper) is selected. If the input signal is 0-10mA, choose 0-5V and connect 500ohm resistor in parallel. Recommended input is 0-20mA for better anti-interference and resolution.	0-20 / 4-20
INC	Input Specification	INC adjusts the input signal, altering the magnitude of input and limit the maximum 3-phase triggering output. For example, setting INC=-50% will decrease the input signal by 50%. If the input signal is voltage at 3V, the output will be limited to that from 1.5V input.	-90% ~ +20%
FILt	Digital Filter	FIL define the strength of noise filtering. When a large value is set, the measurement input is stabilized but the response speed is slow. If there is a strong interference, FILt can be increased gradually.	10 ~ +300
OPrt	Soft Start Time	This soft start time constant refers to the time required for the output changes from 0 to 100% in order to lower the impact for the load device. It is better for silicon molybdenum rods, graphite, tungsten and etc which having inductive loads of transformers. Please note that for furnace control, if OPrt value is too large, the response will be lowered thus reducing the control efficiency.	0 ~ 3600 second

4. APPLICATION

4.1 Indication of run and alarm

There are two indication lamps "RUN" and "ALM" on the case. RUN lamp flashes when normal motion power signal is detected. Trigger signals are also outputted. ALM lamp turns on when failure is detected such as missing phase or incorrect wiring. There will be no triggering output. The alarm relay will be closed.

4.2 Soft-start

AIJK has the function of soft-start which can decrease the shock to load and is suitable for inductive loads with transformer, such as tungsten filaments, MoSi2 and graphite heating elements. An external E8 keypad is needed to adjust OPrt parameter which is the soft-start time constant (Ranging 0-3600 seconds). This start time constant refers to the time required for the output changes from 0 to 100% in order to lower the impact for the load device. Please note that for furnace control, if OPrt value is too large, the response will be lowered thus reducing the control efficiency.

Example of OPrt values are as below:

OPrt Parameter	Soft-start time constant (seconds)
OPrt=1	1
OPrt=2	2
OPrt=11	11 (suitable for soft-start of electromotor)

* Factory value of OPrt is 6 seconds

4.3 Power Phase missing detection alarm

AI-JK30 / AI-JK33 thyristor triggers are able to detect missing of power phase. When missing phase is detected and alarm is activated, three phases stop the output and the red alarm lamp turns on. The alarm is also output to the alarm relay with further triggering flash-light alarm or cutting off the source power of the load.

4.4 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.

4.5 3-phase 4-wire wiring and how to correctly choose the neutral wire

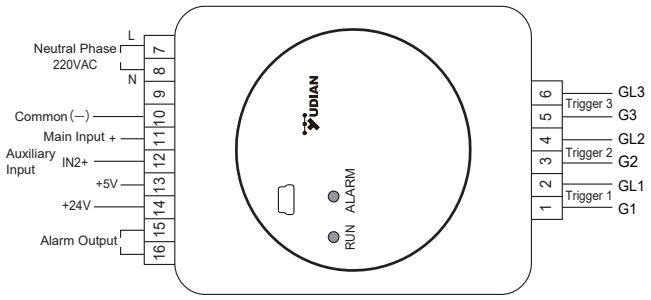
If the load is a furnace and the load on the three phases is different (for example, silicon carbide heating elements), three-phase four-wire wiring can balance better than three-phase three-wire wiring. In addition, the open circuit failure of any phase in a three-phase four-wire system can be detected 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 then 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.

4.6 Compatibility with AI- instruments

When AIJK thyristor trigger modules are used with AI- instrument, it is recommend to use 0~20mA input and to set the parameters of the instrument as such 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 CtI should be greater than the time of soft-start.

5. WIRING DIAGRAM

5.1 Wiring terminals

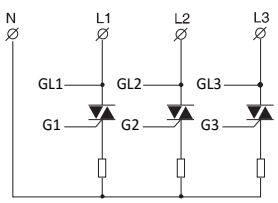


Remark 1: For AI-JK10, only “Trigger 2” is connected. (Corresponding terminals are 3 and 4). If the load is single phase 220V, terminal 7 and 8 are connected to power phase L and neutral N correspondingly. If the load is single phase 380V, terminal 8 is connected to power phase L2 while terminal 7 is connected to power neutral N. The power of main control loop is connected to power phase L1.

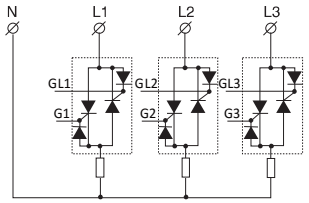
Remark 2: For AI-JK33, the trigger output G1/GL1, G2/GL2 and G3/GL3 are directional. Terminal 7and 8 as power phase and power neutral cannot be connected in reverse polarity. The wire connection must be strictly followed otherwise it will not work or unwanted trigger is occurred. For AI-JK30, trigger output works for either polarity.

5.2 Thyristor firing output

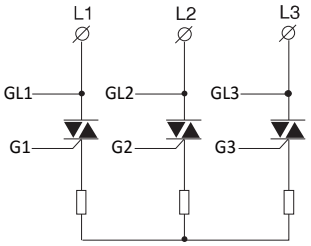
There are 3 loops of trigger outputs. Terminals (1 and 2), (3 and 4) and (5 and 6) are triggering 3 loops of thyristor respectively. For AI-JK30, either 1 loop or 2 loops of triggering outputs can be used. The wiring graphs are as below:



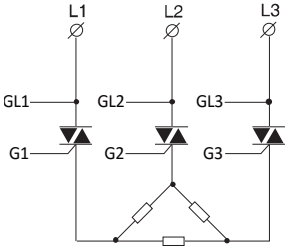
AIJK30 in 3-phase 4-wire Star System
(TRIAC Circuit)



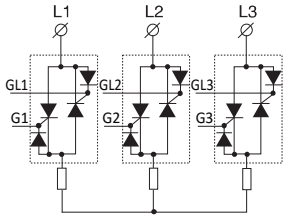
AI-JK30 in 3-phase 4-wire Star System
(SCR inverse parallel circuit, MCC series
power modules recommended)



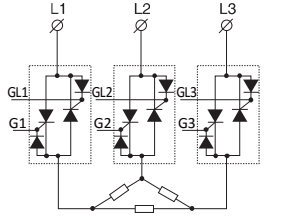
AIJK33 in 3-phase 3-wire
Full Control Star System



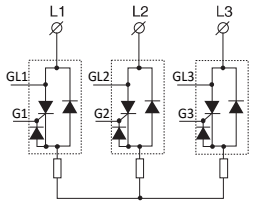
AIJK33 in 3-phase 3-wire
Full Control Delta System
(TRIAC Circuit)



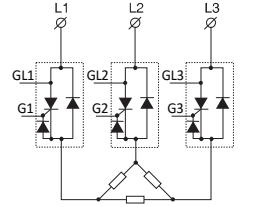
AIJK33 in 3-phase 3-wire Full control Star System
(SCR inverse parallel circuit, MCC series
power modules recommended)



AIJK33 in 3-phase 3-wire Full control Delta System
(SCR inverse parallel circuit, MCC series
power modules recommended)



AIJK33 in 3-phase 3-wire Half Control Star System
(SCR + diode circuit, MCD series
power modules recommended)



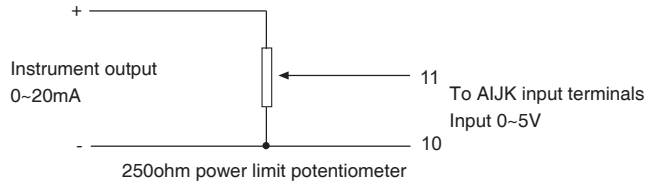
AIJK33 in 3-phase 3-wire Half Control Star System
(SCR + diode circuit, MCD series
power modules recommended)

5.3 High Frequency Interference

Phase-shifting triggering will bring up interference at 1~100Hz frequency. Phase-shifting triggering module should be installed close to the thyristor but keeping a certain distance from the power line. The triggering wires should be as short as possible. Triggering wires of different phases should be avoided in parallel routing. Both ends of all thyristors should be connected in parallel with resistance-capacitance absorption and varistor protection devices, to reduce high-frequency interference and protect the thyristor.

5.4 Manual Power Limit

Besides current feedback method, the output power can be limited manually by connecting a potentiometer between AIJK and the controlling instrument. For example, for the high temperature furnace of MoSi2 or silicon carbide heating elements, a 250 ohms potentiometer with power greater than 1/2W can be applied. The control instrument outputs 0~20mA when AIJK is selected as 0~5V input. The wiring graph is as below:



5.5 Manual Power Adjustment

Making use of the 5V voltage output of AIJK, connecting a 1K potentiometer to terminals 10, 11 and 13 can also achieve manual power adjustment. The trigger should be configured to take 0~5V voltage input (INP=0-20 with DIP switch selected as voltage input. Adding a switch can implement automatic/manual switching.

*There are two DIP switch on the board of triggering unit, selecting input as current or voltage for main input (IN1) and IN2.