KS02H Active Opto–electronic Protective Device

OPERATION MANUAL

(2019·1)

◇ KS02H Active Opto–electronic Protective Device is for use where personnel protection is required, please read this manual carefully before Installation and Utilization.

◇ The operation manual is an important document to guide users to install and use the Active Opto–electronic Protective Device correctly. Agents, dealers and machine factories have the obligation to hand over this manual along with the devices to customers.

Shandong Keli Opto–electronic Technology Co., Ltd.
Manufacturer: Jining Keli Photoelectronic Industrial Co., Ltd.

TEL: +86–537 2168110 or 2338345  FAX: +86–537 2331667
WEB: www.sdkeli.com  Service Tel: 400 666 0416
ADD: A3 building, Industry & Education & Research base of Jining National
    High–tech Zone, Shandong, China  ZIP: 272000
Preface

Thank you for using “SDKELI” Active Opto-electronic Protective Device.

KS02H Active Opto-electronic Protective Device, which is mainly applied in forging industry, protects the operator assorting with punching equipment.

This device only protects the rectangular area between emitter and receiver. If its installation position is not correct, or the operation is not carried on under the instructions or relevant security operational provisions, or there is a fault in the actuating mechanism of machine, the device will fail to work properly. So, before using this device, please read this manual carefully to fully understand relevant items, especially the content marked with “WARNING”, “NOTICE” in the manual. In the course of use, please comprehend the working function of AOPD correctly, operate in strict accordance with the instructions or relative security operational provisions.

This manual only introduces the application of AOPD on the press, when this type of AOPD is applied under other occasions, this manual is only for reference.

Our company reserves the final right to interpret this manual, if you have any doubt in reading or using this manual, please contact us or access http://www.sdkeli.com.
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UNIT 1 BASIC INSTRUCTION

I APPLICATION SCOPE
I.1 AOPD can be applied to all kinds of press machine, such as punch press, straight press, hydraulic press, forging press, filming press, molding press, injection molding machine, powder metallurgy molding press, plate shearing machine, bending machine, paper cutter, etc., to protect the operator.
I.2 For presses on which the slider can stop at any point in one stroke, it can achieve the Full–trip protection, and it can also achieve the protection from 30° to 180° in one stroke assorting with the cam switch.
I.3 For presses on which the slider can not stop anywhere in one stroke, AOPD only achieves top stop protection at the end of the last stroke—when the last stroke has already finished, but the next stroke is not activated yet, if the light curtain is on shading state, the next slider stroke will not start.
I.4 Regional protection can be achieved for industrial robot, packaging equipment, automation equipment, welding production line, etc., which are regarded as dangerous areas.
I.5 AOPD can also be used for detection and prevention of burglary.

II FEATURES
II.1 Sound self–test functions
The AOPD has the self–test function. When the device is at fault state, the OSSD outputs will turn to the “OFF” state.
But this device can not detect whether the control signal circuit failure to danger resulted by external physical damage or wrong wiring. So designation, installation and wiring must be carried out strictly in terms of this manual.
II.2 Start–restart interlock function can be set up
If any light beam of the light curtain is blocked, the press slider stops running at once. Even if the light curtain resumes unblocked state, the press slider still keeps stopping, and manual reset is necessary to resume the running of press slider.
The interlock function is not set in the standard configuration.

If the start–restart interlock function is needed, the customer should propose a request when placing the order for AOPD.

Application of Interlock Function
For presses on which the slider can stop at any point in one stroke, this function is unnecessary.
For presses on which the slider can not stop anywhere in one stroke, if the way of feeding material is automatic, the interlock function should be applied. If the way of feeding material is manual, it is necessary to apply interlock function.
It is commonly used reset button or reset switch down–lead to fullfill interlock function. Please refer to “OPERATION” in UNIT 5 to see how to use it.
II.3 High capacity of resisting disturbance
The system possesses high capacity of resisting disturbance against electromagnetic signal, strobe light, jointing arc light and surrounding light source etc..

II.4 Easy beam-focusing
   Scientific and skillful designed optical system, particular selected components.

II.5 Good vibration resistance

II.6 Convenient and diversified installation
   We can provide the regular installation forms such as common side mounting, ZC mounting, pipe mounting, double-arm mounting, T-groove mounting, scatter shield mounting or magnetic mounting. We can also make special support to meet the requirement of customer.

II.7 Long performance life and high reliability
   Output relay is replaceable after reaching the end of its performance life.

III DESIGNATION

In order to protect the operator from injury, all the presses should be equipped with AOPD.

III.1 For presses on which the slider can stop at any point in one stroke, AOPD can be directly used in conjunction with the press.

III.2 For presses on which the slider can not stop anywhere in one stroke, if the coupling union power of clutch is electromagnetic force or gas, fluid power, AOPD can be directly used in conjunction with the press; if the coupling union power of clutch is manpower, AOPD can not be used in conjunction with the press before the dynamic form transformation—namely transform manpower into electromagnetic force or gas, fluid power.

III.3 KS02HB AOPD is applied to the machine of which the protective length is less than 9m.

III.4 Protective height \( \geq \) Length of Slider Stroke + Regulating Variable of Slider Stroke

III.5 Controller can be selected in accordance with the accessibility requirements, choosing CPSI controller or CQ1 controller; for the machine controlled by level signal(NPN or PNP), JK interface or the KS02HG safety light curtain should be selected.

If the power cable is exposed outside of the machine electrical cabinet, there is a danger that the device will failure to danger resulted by physical damage, so CQ1 controller should be selected priority because it can be installed inside of the electrical cabinet. If CPSI controller is selected, it must be installed nearest by the electrical cabinet and protective measurements should be adopted. Meanwhile special person must examine it carefully before each duty.

III.6 The AOPD with the detection capability of 30mm (20mm beam spacing) is applied to the occasions of palm protection, The AOPD with the detection capacity of 50mm (40mm beam spacing) applied to the occasions of body protection such as arm.

III.7 When there is no special request, we will supply the power cable and transmission cable with standard length.
IV  PRINCIPLE AND STRUCTURE

IV.1 Schematic illustration of working principle

![Working principle illustration of KS02H AOPD](image)

**Fig 1.1** Working principle illustration of KS02H AOPD

![Working principle illustration of KS02HG safety light curtain](image)

**Fig 1.2** Working principle illustration of KS02HG safety light curtain

IV.2 Build-up unit

IV.2.1 Control Devices

The controller supplies power for emitter and receiver; processes signals transmitted from receiver and sends out signal through output signals switching device (OSSD), controlling the forced stroke stop circuit or alarm circuit of machine.

Controller is divided into three types, namely CPSI controller, CQ1 controller and JKIII interface. CPSI controller and CQ1 controller use relays as the output signal switching device and JKIII interface uses transistor as the output signal switching device.

The AOPD with the controller is strongly suggested to use by customers because of its thorough self-test function. If the customer insists on not using the controller, our company does not assume any liability for failure due to lack of the controller.

IV.2.1.1 CPSI Controller

It is placed outside the control unit of machine, commonly mounted on the machine bed support, supplying power for emitter and receiver, processing signals and sending out stop signal to machine control system when the light curtain is on shading state or there is a fault of AOPD.
Fig 1.2.A CPSI controller—single-side protection

Fig 1.2.B CPSI controller—double-side protection

Sheet 1.1 Operating state of CPSI

<table>
<thead>
<tr>
<th>Power switch</th>
<th>Function switch</th>
<th>Power indicator (Orange)</th>
<th>Non-protection indicator (Red)</th>
<th>Normal operation indicator (Green) Unblocked</th>
<th>Blocked</th>
<th>Unusual station indicator (Red) Unblocked</th>
<th>Blocked</th>
<th>Operating state of AOPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON Protection</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>ON Non-protection</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Non-protection</td>
</tr>
<tr>
<td>OFF Protection</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Protection</td>
</tr>
<tr>
<td>OFF Non-protection</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Protection</td>
</tr>
</tbody>
</table>
When the AOPD is on non-protection, other safety preventive measures need to be adopted!

- Single-side protection controller used with one set of sensors (emitter/receiver) to provide one side protection of the operating zone, as shown in Fig.1.2.A.

- Double-side protection controller used with two sets of sensors (emitter/receiver) to provide two sides protection of the operating zone, as shown in Fig.1.2.B.

- Selection switch: Selection switch is set on the panel of double-side protection controller to set detection zone.

  When the switch is pointed to “A”, the relevant light curtain is activated and “B” side light curtain is bypassed.

  When the switch is pointed to “B”, the relevant light curtain is activated and “A” side light curtain is bypassed.

  When the switch is pointed to “Both”, both of light curtains are activated at the same time.

- Reset button: For the controller with manual reset function, it is set on the panel, while for the controller with automatic reset function, there is no reset button.

IV.2.1.2 CQ1 controller

It is placed inside control unit of machine, supplies power for emitter and receiver, processes the signals, sends out stop signal to machine control system when the light curtain is on shading state or there is a fault of AOPD.
Sheet1.2 Operating state of CQ1

<table>
<thead>
<tr>
<th>Power switch</th>
<th>Function switch</th>
<th>Power indicator (Orange)</th>
<th>Non-protection indicator (Red)</th>
<th>Normal operation indicator (Green)</th>
<th>Unusual station indicator (Red)</th>
<th>Operating state of AOPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>Protection</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON Protection</td>
</tr>
<tr>
<td></td>
<td>Non-protection</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>Non-protection</td>
</tr>
<tr>
<td>OFF</td>
<td>Protection</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Protection</td>
</tr>
<tr>
<td></td>
<td>Non-protection</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>Protection</td>
</tr>
</tbody>
</table>

When the AOPD is on non-protection, other safety preventive measures need to be adopted!

IV.2.1.3 JKIII interface

JKIII interface is designed for systems controlled by level signal, such as PLC system. It is commonly placed inside the electrical cabinet of machine.

- Power indicator (Red): if the power is on, the indicator is on;
- Driving signal indicator (Green): if the transistor conducts, the indicator is on.

Declaration about output state:
The way that the transistor conducts when the light curtain is unblocked is the safe mode.
The way that the transistor conducts when the light curtain is blocked is the non-safe mode. Under this way, being disconnecting or poor contacting of any circuit will cause control failure.

Non-safe mode is not supposed to be selected by customer! If customer insists using this mode, our company will not be responsible for control failure resulted by wiring.

IV.2.2 Emitter

Emitter is a complex of luminous units, emitting optical signals to receiver.

IV.2.3 Receiver

Receiver is a complex of light-receiving units, processing optical signals from emitter and sending them to control devices.
IV.2.4 Transmission cable

The transmission cable is utilized for transmitting signals between emitter, receiver and controller. The connection points are shown in Fig1.6.

The standard length of transmission cable is shown in Sheet1.3.

The customer should make special order if the standard transmission cable does not meet the actual requirements.

Sheet1.3 Standard length of transmission cable

<table>
<thead>
<tr>
<th>Transmission Cable</th>
<th>KS02HB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double-end</td>
<td>A–2.5m &amp; 4m</td>
</tr>
<tr>
<td>B–2.5m &amp; 6m</td>
<td></td>
</tr>
<tr>
<td>Single-end</td>
<td>A–3m &amp; 5m</td>
</tr>
<tr>
<td>B–3m &amp; 7m</td>
<td></td>
</tr>
</tbody>
</table>

Fig1.5 Emitter/Receiver

Fig1.6 A Double-end transmission cable for KS02H AOPD
IV.2.5 Power cable

The power cable connects AOPD with power supply, transmits signal sent from controller to electric equipment of machine and other controlled systems. The connection points are shown in Fig 1.7.

The standard length of power cable: 2.5m for CPSI; 1.5m for CQ1 and JKIII.
V INSTRUCTION OF SPECIFICATION

The entire machine specification of AOPD with the relay contact output is as follows:

- Form of installation: shown in sheet 1.4
- Form of reset: R-auto, M-manual
- Power supply: A-AC100V to 230V, D-DC24V
- Form of output: 1O-one group of NO contacts
- 1C-one group of NC contacts
- P -CPS I controller, single-side protection
- PS -CPS I controller, double-side protection
- Q -CO1 controller, power switch and function switch
- QN-CQ1 controller, no switch
- Beam spacing: 20-20mm, 40-40mm
- No. of beams: 04, 06, 08......32
- Protective length: 0 to 9m

The entire machine specification of AOPD with the transistor output is as follows:

- Form of installation: shown in sheet 1.4
- T-transistor turns on when light curtain is unblocked
- Z-transistor turns on when light curtain is blocked
- Form of output: N- NPN output, P-PNP output
- No. of output switches: 2-double output
- J-JKIII interface, G-safety light curtain
- Beam spacing: 20-20mm, 40-40mm
- No. of beams: 04, 06, 08......32
- Protective length: 0 to 9m

The specification of CPSI controller is as follows:

- Form of reset: R-auto, M-manual
- Power supply: A-AC100V to 230V, D-DC24V
- Form of output: 1O-one group of NO contacts
- 1C-one group of NC contacts
- D-correlative light curtain
- D- single-side protection, S- double-side protection
- CPS I controller
The specification of CQ1 controller is as follows:

- Form of reset: R-auto, M-manual
- Power supply: A-AC100V to 230V, D-DC24V
- Form of output: 10-one group of NO contacts
  1C-one group of NC contacts
- No. of switches: S-power switch and function switch
  N-no switch

CQ1 controller

The specification of JKIII interface is as follows:

- T-transistor turns on when light curtain is unblocked
- Z-transistor turns on when light curtain is blocked
- Form of output: N- NPN output, P-PNP output
- No. of output switches: 2-double output
- Output voltage: 24-DC24V
- Input voltage: 24-DC24V

JKIII interface

The specification for emitter/receiver of the KS02H AOPD is as follows:

- E-Emitter, R-Receiver
- Beam spacing: 20-20mm, 40-40mm
- No. of beams: 04, 06, 08……32
- Protective length: 0 to 9m

KS02H AOPD

The specification for emitter/receiver of the KS02HG safety light curtain is as follows:

- T-transistor turns on when light curtain is unblocked
- Z-transistor turns on when light curtain is blocked (only for receiver)
- Form of output: N- NPN output, P-PNP output (only for receiver)
- No. of output switches: 2-double outputs (only for receiver)
- E-Emitter, R-Receiver
- G-Safety light curtain
- Beam spacing: 20-20mm, 40-40mm
- No. of beams: 04, 06, 08……32
- Protective length: 0 to 9m

KS02HG safety light curtain
The specification of power cable is as follows:

The specification of transmission cable is as follows:

Sheet 1.4 Code of bracket installation

<table>
<thead>
<tr>
<th>No</th>
<th>Form</th>
<th>Code</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common side mounting</td>
<td>PC</td>
<td>P21</td>
</tr>
<tr>
<td>2</td>
<td>ZC mounting</td>
<td>ZC</td>
<td>P22</td>
</tr>
<tr>
<td>3</td>
<td>Pipe mounting</td>
<td>GC</td>
<td>P24</td>
</tr>
<tr>
<td>4</td>
<td>Double-arm side mounting—with reducer</td>
<td>SCJ</td>
<td>P25</td>
</tr>
<tr>
<td>5</td>
<td>Double-arm side mounting—T–groove</td>
<td>SCT</td>
<td>P27</td>
</tr>
<tr>
<td>6</td>
<td>T–groove mounting</td>
<td>TC</td>
<td>P28</td>
</tr>
<tr>
<td>7</td>
<td>Scatter shield side mounting</td>
<td>FC</td>
<td>P29</td>
</tr>
<tr>
<td>8</td>
<td>Scatter shield front mounting</td>
<td>FZ</td>
<td>P29</td>
</tr>
<tr>
<td>9</td>
<td>Scatter shield pipe mounting</td>
<td>GF</td>
<td>P30</td>
</tr>
<tr>
<td>10</td>
<td>Scatter shield double-arm mounting</td>
<td>SF</td>
<td>P31</td>
</tr>
<tr>
<td>11</td>
<td>Magnetic attachment mounting</td>
<td>CX</td>
<td>P33</td>
</tr>
<tr>
<td>12</td>
<td>Scatter shield magnet front mounting</td>
<td>CFZ</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Scatter shield magnet side mounting</td>
<td>CFC</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Double-bracket arm mounting</td>
<td>GI</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Plate support with magnet mounting</td>
<td>BC</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Plate support with bolt mounting</td>
<td>BL</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Scatter shield column mounting</td>
<td>FL</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Other forms of bracket</td>
<td>XX</td>
<td></td>
</tr>
</tbody>
</table>

These installation forms are not illustrated in this operation manual, please contact us for more details before you want to use them.

Other forms of bracket should be rasied in the contact by customer and the code of it will be made by us.
### VI TECHNICAL PARAMETERS

#### Sheet 1.5 Technical parameters of CPSI/CQ1

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>AC100V to 230V±15%, 50/60Hz</td>
</tr>
<tr>
<td>Output form</td>
<td>Relay contact output</td>
</tr>
<tr>
<td>Contact capacity</td>
<td>5A, AC250V/DC30V (resistive load)</td>
</tr>
<tr>
<td>Power consumption</td>
<td>≤15W</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>-10°C to 55°C</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>35% to 85%RH</td>
</tr>
<tr>
<td>Response time</td>
<td>≤20ms</td>
</tr>
<tr>
<td>Insulating resistance</td>
<td>≥100MΩ</td>
</tr>
<tr>
<td>Performance life of relay</td>
<td>≥10^6 Times</td>
</tr>
<tr>
<td>IP code</td>
<td>CPSI: IP54</td>
</tr>
<tr>
<td></td>
<td>CQ1: IP20</td>
</tr>
</tbody>
</table>

#### Sheet 1.6 Technical parameters of JKIII

<table>
<thead>
<tr>
<th>Output form</th>
<th>Output characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>JKI-□□□□-2NT</td>
<td>NPN output and transistor conducts when light curtain is unblocked</td>
</tr>
<tr>
<td>JKI-□□□□-2PT</td>
<td>PNP output and transistor conducts when light curtain is unblocked</td>
</tr>
<tr>
<td>JKI-□□□□-2NZ</td>
<td>NPN output and transistor conducts when light curtain is blocked</td>
</tr>
<tr>
<td>JKI-□□□□-2PZ</td>
<td>PNP output and transistor conducts when light curtain is blocked</td>
</tr>
<tr>
<td>Output current</td>
<td>≤300mA</td>
</tr>
<tr>
<td>Source isolation form</td>
<td>DC-DC</td>
</tr>
<tr>
<td>Output isolation form</td>
<td>Optically Coupled Isolation</td>
</tr>
<tr>
<td>IP code</td>
<td>IP20</td>
</tr>
</tbody>
</table>

#### Sheet 1.7 Technical parameters of KS02H AOPD and KS02HG safety light curtain.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executed standard</td>
<td>GB4584–2007</td>
</tr>
<tr>
<td>Beam spacing</td>
<td>20mm, 40mm</td>
</tr>
<tr>
<td>Detection capability</td>
<td>30mm, 50mm</td>
</tr>
<tr>
<td>No. of beams</td>
<td>6, 8, 10…32, 4, 6, 8…32</td>
</tr>
<tr>
<td>Protective length</td>
<td>0 to 9m</td>
</tr>
<tr>
<td>Response time</td>
<td>KS02H: ≤20ms(entire machine)</td>
</tr>
<tr>
<td></td>
<td>KS02HG: ≤20ms</td>
</tr>
<tr>
<td>Ambient illumination</td>
<td>10000Lux(angle of incidence ≥5°)</td>
</tr>
<tr>
<td>Power supply</td>
<td>KS02H: DC12V±10%</td>
</tr>
<tr>
<td></td>
<td>KS02HG: DC24V±10%</td>
</tr>
<tr>
<td>Output characteristic</td>
<td>KS02H, While unblocked, output 4KHz square wave</td>
</tr>
<tr>
<td></td>
<td>NPN unblocked: 200mA, DC0V to 4V; blocked: open, (DC24V, leak current&lt;2mA)</td>
</tr>
<tr>
<td></td>
<td>PNP unblocked: 200mA, DC20V to 24V; blocked: open, (DC0V, 10kΩ resistance to ground)</td>
</tr>
<tr>
<td>IP code</td>
<td>IP65</td>
</tr>
</tbody>
</table>
## VII DIMENSIONS OF MAJOR PARTS

### Sheet 1.8 Dimensions of H, J and L

(Unit: mm)

<table>
<thead>
<tr>
<th>No. of beams</th>
<th>Beam spacing 20mm</th>
<th></th>
<th>Beam spacing 40mm</th>
<th></th>
</tr>
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<td>1000</td>
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H—protective height, J—length of emitter/receiver, L—length of steel pipe and double-arm pipe

Note: The maximum length of double-arm pipe is 1500mm.
Controller support  Emitter/Receiver  Double-arm pipe  Support seat

Steel pipe  Bracket arm  Bracket seat

Q–clamp  KS pipe–mounting fixing clamp  Ω–clamp
KS common side-mounting bracket

ZC-mounting bracket

L-bracket

KS shield-mounting bracket

KS02 upper vibration–reducer

KS02 lower vibration–reducer

KS scatter shield (C is shown on Page 32)

Fig 1.8 Detail drawing of major parts
UNIT 2 INSTALLATION

As soon as you receive our goods, check the items inside the box according to packing list.
Before installation, shut down the power supply to avoid possible danger.

I INSTALLATION SITE

The installation site contains two factors, that is safety distance and relative altitude position.

To ensure personal safety, the installation site of AOPD must meet the requirements for safety distance and relative altitude position. Otherwise, the accident may occur.

I.1 Safety distance

The safety distance is the minimum distance that must be set between the light curtain of AOPD and the margin of mould orifice to stop the hazardous part before a person or object reaches it. Its algorithmic method should be defined according to the brake mode of the machine or refer to Sheet2.1.

![Safety Distance Chart](chart.png)

**Sheet2.1 Calculation sheet for safety distance**

- For presses on which the slider can stop at any point in one stroke, the safety distance can be worked out according to formula (1).

\[ S = KT + C \]  

(1)

Where:

- S — Safety distance (in mm) from the light curtain sensing field to the danger zone
- K — Velocity (in mm/s) of movement into the danger zone
- T — Total response time (in s) of the system, including the response time of the AOPD (informed by the supplier) and the braking time of the press (should be measured by actual time)
- C — Additional safety distance (in mm)

- For presses on which the slider can not stop anywhere in one stroke, the safety distance can be
worked out according to formula (2).
\[ S = KT_s + C \]  \hspace{1cm} (2)

Where:
- **S** — Safety distance (in mm) from the light curtain sensing field to the danger zone
- **K** — Velocity (in mm/s) of movement into the danger zone
- **C** — Additional safety distance (in mm)
- **Ts** — Time (in s) from the press slider starts from the upper dead point to the press slider arrives at the lower dead point, name the stroke down time of press slider. Ts can be calculated according to formula (3) or measured by actual time
\[ Ts = \left( \frac{1}{2} + \frac{1}{N} \right)T_n \]  \hspace{1cm} (3)

Where:
- **N** — Number of stoats of clutch
- **Tn** — Time (in s) needed for crankshaft to make a cycle

**The value of K:**
- To adopt parallel approach of installation, the value of K uses 1600mm/s.
- To adopt vertical approach of installation, the value of K uses 2000mm/s if S≤500mm, the value of K uses 1600mm/s if S>500mm.

**The value of C:**
- The value of C should be set by the maximal length of the arm which puts into the light curtain sensing field but not cause the AOPD to response.
- The value of C should be set according to the detection capability, shown in the following table.

<table>
<thead>
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<th>Detection Capability (mm)</th>
<th>C (mm)</th>
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<td>&gt;14 to 20</td>
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<td>&gt;20 to 30</td>
<td>130</td>
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The safety distance is one of the necessary conditions for achieving the protection function of AOPD. The calculation about safety distance must be correct and accurate. The safety distance must be ensured while installing AOPD.

**1.2 Relative altitude height**

Relative altitude height refers to the upper and lower position of light curtain relative to the die orifice of machine. On the premise of ensuring the safety distance, the lowest light beam of AOPD must not be higher than the lower edge of low die orifice, and the highest light beam of AOPD must not be higher than the upper die orifice. See Fig2.1.1, this is related to the selection of the protective height of AOPD.
Relative Altitude Height $\geq$ Length of Slider Stroke + Regulating Variable of Slider Stroke

Fig 2.1.1 The correct position of installation site

Fig 2.1.2 Incorrect position of installation site
— light curtain is too close to die orifice.

Fig 2.1.3 Incorrect position of installation site
— light curtain is too high, the hand can stretch into it under the lowest beam.

Fig 2.1.4 Incorrect position of installation site
— light curtain is too low, the hand can stretch into it upside the highest beam.
The relative altitude height is one of necessary conditions for achieving the protection function of AOPD, the relative altitude height must be ensured while installing AOPD. If the brake staff of press slider is at fault, it must be checked and repaired in time. Otherwise even if the installation site is correct, the risk of accident exists. If the die is changed in the course of using AOPD, the safety distance and relative altitude height must be readjusted according to the requirements above.

I.3 Auxiliary protective equipment

If the distance between light curtain and die orifice is over 400mm, auxiliary protective equipment should be installed to prevent operator from entering the danger zone, it is shown in Fig.2.1.5. If this distance is no more than 400mm, auxiliary protective equipment may also be adopted.

Fig 2.1.5 Incorrect position of installation site—light curtain is too far from die orifice, operators could enter danger zone.

II INSTALLATION TOOL

Electric drill, Aiguilles (specification: Ф4.2/Ф5.2/Ф6.7/Ф10)
Taps (specification: M5/M6/M8) Cross-ended screwdriver,
Knife-ended screwdriver, Inner-hexagon wrench (specification: 4#/5#/6#)
8# adjustable wrench, Long flat nose pliers.

● To install controller support, ZC—mounting bracket, scatter shield or controller support: a Ф5.2 aiguille and a M6 tap;
● To install bracket seat or support seat: a Ф6.7 aiguille, a M8 tap;
● To install CQ1 controller and JKI interface: a Ф4.2 aiguille;
● To drill the cable—passing hole of transmission cables and power cables: a Ф10 aiguille.

III INSTALLATION OF CONTROL DEVICE

III.1 Installation of CPSI controller

CPSI is installed on the bed support of machine by controller support, the procedures are as follows:
1. Select proper position according to the external dimensions of the controller.
2. According to the mounting dimensions of controller support, fix the support well, as shown in Fig2.2.
3. Install the controller on the support through shock absorber and its bowl, the procedures are as follows:
• Take off two shock absorbers from the upper part of the support, and then put them into the shock absorber bowl of the upper part of controller.

• Aim the shock absorber bowl of the lower part of the controller at the shock absorbers of the lower part the support, and then assemble the shock absorber and its bowl. Push forward the controller into its support; make the tapped holes of shock absorbers to be aimed at the holes of the upper part of the support.

• Tighten the two M5×10 cross recessed screws to fix firmly the two shock absorbers to the upper part of the support.

III.2 Installation of CQ1 Controller

CQ1 controller is directly fixed onto the 35mm guide rail inside the control unit of machine, see Fig 2.3.

III.3 Installation of JKIII Interface

JKIII interface can be installed into the electrical cabinet by 35mm guide rail or M4 screws, two ways in total, see Fig 2.4.
IV INSTALLATION OF EMITTER/RECEIVER

Before installation, safety distance and relative altitude height must be calculated and defined correctly.

IV.1 Common side mounting (PC)

The way to install emitter and receiver through KS common side–mounting bracket directly on bed piece, is generally applied to straight side press of support construction. The form of installation is shown in Fig2.5.

Sheet2.2 Formula of Dimension A, B and H

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<th>Dimension</th>
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<th>Formula</th>
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H–protective height

①Emitter/Receiver  ②KS common side–mounting bracket  ④KS02 lower vibration–reducer
⑤KS02 upper vibration–reducer  ⑥M6×16 inner hexagon screw, Φ6 elastic/plain washer
1. On the premise of ensuring the safety distance, select proper installation position on the machine bed piece, drill and tap according to dimensions shown in Fig 2.5.C. Attention must be paid to locating the drilling hole to ensure that the emitter and receiver is parallel and aligned after being installed.

2. Fit KS02 upper vibration-reducer and KS02 lower vibration-reducer in the mounting hole of KS common side-mounting bracket, according to the assembly direction with the emitter and receiver.

3. Fix KS common side-mounting bracket located below onto the machine bed piece through M6×16 inner hexagon screws.

4. Mount the Emitter/Receiver with vibration-reducer on the KS common side-mounting bracket fixed on the machine bed, then mount the other KS common side-mounting bracket on the Emitter/Receiver. Fix the KS common side-mounting bracket through M6×16 inner hexagon screws.

5. Adjust the position of emitter and receiver, make them parallel, corresponding and aligned.

6. Fasten all mounting screws after start-up test.

IV.2 ZC mounting (ZC)

The way to install emitter and receiver through ZC-mounting bracket directly on bed piece is generally applied to straight side press of support construction. The form of installation is shown in Fig 2.6.
Sheet2.3 Formula of Dimension A, B and H

<table>
<thead>
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<td></td>
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<td>B=H+126</td>
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</table>

H—protective height

1. In the premise of ensuring the safety distance, select proper installation position on the machine bed piece, drill and tap according to dimensions shown in Fig2.6.C. Attention must be paid to locating the drilling hole to ensure that the emitter and receiver are parallel and aligned after being installed.

2. Fit KS02 upper vibration—reducer and KS02 lower vibration—reducer in the mounting hole of ZC—mounting bracket, according to the assembly direction with the emitter and receiver.

3. Fix ZC—mounting bracket located below onto the machine bed piece through M6×16 inner hexagon screws.

4. Mount the Emitter/Receiver with vibration—reducer on the ZC—mounting bracket fixed on the machine bed, and then mount the other ZC—mounting bracket on the Emitter/Receiver. Fix the ZC—mounting bracket through M6×16 inner hexagon screws.

5. Adjust the position of emitter and receiver, make them parallel, corresponding and aligned.

6. Fasten all mounting screws after start—up test.
IV.3 Pipe mounting (GC)

Emitter/Receiver is fixed on the machine through an adjustable pipe-mounting support. This way is generally applied to open press and four column hydraulic press. The form of installation is shown in Fig2.7.

1. Install the adjustable pipe-mounting support
   ● Select proper position from two sides of machine, drill and tap according to dimensions shown in Fig2.7.A. Fix the bracket seat onto the machine bed piece by M8×20 inner hexagon screws.
   ● Fix the bracket arm on the bracket seat by M16×45 hexagon screw.
   ● Insert steel pipe into the round hole of bracket arm, adjust it to a proper height, and properly tighten the M8×25 inner hexagon screw.

2. Install the two KS pipe-mounting fixing clamps on the steel pipe, adjust the lower clamp to a proper position, properly tighten the M5×25 inner hexagon screw, as shown in Fig2.7.C.

3. Fit KS02 upper vibration-reducer and KS02 lower vibration-reducer on Emitter/Receiver, and make sure that the KS02 lower vibration-reducer is on the side of the Emitter/Receiver with multipin connector for transmission cable.


5. Adjust the position of emitter and receiver, make them parallel, corresponding and aligned.

6. Fasten all mounting screws after start-up test.

---

Fig2.7 Pipe mounting (GC)

①Bracket seat  ②Bracket arm  ③Steel pipe  ④Emitter/Receiver
⑤KS pipe-mounting fixing clamp  ⑥KS02 upper vibration-reducer  ⑦KS02 lower vibration-reducer
⑧M16×45 hexagon screw, Φ16 elastic/plain washer
⑨M5×25 inner hexagon screw, Φ5 elastic washer, M5 square nut
⑩M8×25 inner hexagon screw, Φ8 elastic washer
⑪M8×20 inner hexagon screw, Φ8 elastic washer
IV.4.1 Double-arm side mounting—with reducer (SCJ)

1. According to the safety distance and relative altitude height calculated in advance, select proper position from two sides of machine tool, drill and tap according to dimensions shown in Fig2.8.1.A. Fix the support seat on the machine bed piece by M8×25 inner hexagon screws.

2. Insert double-arm pipe into the round hole of support seat, adjust it to be worktable of machine tool, properly tighten the M8×25 inner hexagon screws.

3. Put KS02 upper vibration-reducer and KS02 lower vibration-reducer in the mounting hole of KS pipe-mounting fixing clamp according to the assembly direction with the emitter and receiver.

4. Install the two KS pipe-mounting fixing clamps on the double-arm pipe, properly tighten the M5×25 inner hexagon screw.


6. Adjust the position of emitter and receiver, including safety distance, relative altitude height and feathering angle, make them parallel, corresponding and aligned.

7. Fasten all mounting screws after start-up test.
Fig 2.8.1 Double-arm side mounting —— with reducer (SCJ)

1. Support  
2. Double-arm pipe  
3. Emitter/Receiver  
4. 27-clamp  
6. KS02 upper vibration-reducer  
7. KS02 lower vibration-reducer  
8. 9. M8×25 inner hexagon screw, Φ8 elastic washer  
10. M5×20 inner hexagon screw, Φ5 elastic washer, M5 square nut

Fig 2.8.1.A

Fig 2.8.1.B adjustable in the range of 180°

Fig 2.8.1.C

Fig 2.8.1.D
IV.4.2 Double–arm side mounting——T–groove (SCT)

1. According to the safety distance and relative altitude height calculated in advance, select proper position from two sides of machine tool, drill and tap according to dimensions shown in Fig2.8.1.A. Fix the support seat onto the machine bed piece by M8×25 inner hexagon screws.
2. Insert double–arm pipe into the round hole of support seat, adjust it to be worktable of machine tool, properly tighten the M8×25 inner hexagon screws.
3. Fix the Q–clamp on the emitter and receiver through T–bolts and M6 hexagon nuts.
4. Fix the emitter on the double–arm pipe through Q–clamp, adjust the height of emitter to the requirements of the position, properly tighten the screws on the Q–clamp.
5. Fix the receiver on the double–arm pipe through Q–clamp, adjust the height of the receiver with the emitter at the same height, properly tighten the screws on the Q–clamp.
6. Adjust the position of emitter and receiver, including safety distance, relative altitude height and feathering angle, and make them parallel, corresponding and aligned.
7. Fasten all mounting screws after start–up test.

Fig2.8.2 Double–arm side mounting——T–groove(SCT)

---

①Emitter/Receiver  ②Support  ③Double–arm pipe  ④Q–clamp  ⑤T–bolt  ⑥M6 hexagon nut, Φ6 elastic washer  ⑦⑧M8×25 inner hexagon screw, Φ8 elastic washer  ⑨M5×25 inner hexagon screw, Φ5 elastic washer, M5 square nut

Fig2.8.2.A adjustable in the range of 180°  Fig2.8.2.B  Fig2.8.2.C
IV.5 T–groove mounting (TC)

Emitter/receiver contains T–groove itself, when the space is too limited to adopt the three installation forms mentioned above, T–groove installation is another solution for consideration. Fix Emitter/Receiver on machine bed by T–bolts and L–brackets. The form of installation is showing in Fig2.9. The procedures are as follows:

1. Select proper installation position on the machine bed piece, drill and tap as shown in Fig2.9.C.
2. Fix the L–bracket onto the machine bed piece by M6×16 inner hexagon screw.
3. Tightly fix the emitter and receiver onto the L–bracket by T–bolts and M6 hexagon nuts.
4. Adjust the position of emitter and receiver, make them parallel, corresponding and aligned.
5. Fasten all mounting screws after start–up test.

![Fig2.9 T–groove mounting (TC)](image)

---

Sheet2.4 Formula of Dimension D, F and H

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H–protective height
IV.6 Scatter shield installation

To avoid and reduce the loss of Emitter/Receiver caused by collision and impact in the course of use, installing scatter shield is a way to protect Emitter/Receiver.

There are four main forms to install scatter shield, namely scatter shield side mounting, scatter shield front mounting, scatter shield pipe mounting and scatter shield double–arm mounting.

The procedures are as follows:

A. Fix emitter and receiver onto the scatter shield by KS shield–mounting bracket, KS02 upper vibration–reducer and KS02 lower vibration–reducer.

B. Fix the scatter shield onto the support

- For scatter shield side mounting, first, select proper installation position on the machine bed piece; second, drill and tap as shown in Fig.2.10.B; third, fix the scatter shield onto the machine bed piece by four M₆×16 inner hexagon screws. Refer to Fig.2.10.

- For scatter shield front mounting, first, select proper installation position on the machine bed piece; second, drill and tap as shown in Fig.2.11.B; third, fix the shield onto the machine bed piece by two M₆×16 inner hexagon screws. Refer to Fig.2.11.

- For scatter shield pipe mounting, first, fit the pipe–mounting support well; second, fix Ω–clamps on the scatter shield by gaskets and M₆×35 inner hexagon screws; third, fix the scatter shield on the steel pipe by tightening the screws. Refer to Fig.2.12.

- For scatter shield double–arm mounting, first, fit the double–arm mounting support well; second, fix Ω–clamps on the scatter shield by gaskets and M₆×35 inner hexagon screws; third, fix the scatter shield on the steel pipe by tightening the screws. Refer to Fig.2.13.

C. Adjust the position of emitter and receiver, make them parallel, corresponding, aligned.

D. Fasten all installed screws after start–up test.

Fig.2.10 Scatter shield side mounting (FC) Fig.2.11 Scatter shield front mounting (FZ)

4. KS02 lower vibration–reducer  5. KS02 upper vibration–reducer 
6. M₆×12 inner hexagon screw, Φ6 elastic/plain washer 
7. M₆×16 inner hexagon screw, Φ6 elastic/plain washer
Fig2.10.A  
Fig2.10.B  
Fig2.11.A  
Fig2.11.B

Fig2.12 Scatter shield pipe mounting (GF)

① Emitter/Receiver  ② Scatter Shield  ③ KS shield–mounting bracket
④ KS02 lower vibration–reducer  ⑤ KS02 upper vibration–reducer
⑥ M6×12 inner hexagon screw, Φ6 elastic/plain washer
⑦ Gasket  ⑧ Ω–clamp
⑨ M6×35 inner hexagon screw, Φ6 elastic/plain washer
Fig 2.12. Scatter shield double-arm mounting (SF)

1. Emitter/Receiver  
2. Scatter Shield  
3. KS shield–mounting bracket  
4. KS02 upper vibration–reducer  
5. KS02 lower vibration–reducer  
6. M6×12 inner hexagon screw, Φ6 elastic/plain washer  
7. Gasket  
8. Ω–clamp  
9. M6×35 inner hexagon screw, Φ6 elastic washer
### Sheet 2.5  Length of scatter shield

( unit: mm )

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<th>C</th>
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</table>
IV.7 Magnetic attachment mounting (CX)

This way is generally applied to side straight press of bracket construction. The installation is convenient. The form of installation is shown in Fig.2.14.

Select proper position on the bed piece referring to Fig.2.14.A, and absorb emitter and receiver onto the bed piece.

Emitter and receiver should be parallel, corresponding, aligned. If the bed piece of machine is not flat, a steel of 6–10mm thickness could be attached to the bed piece of machine.

Fig.2.14 Magnetic attachment mounting (CX)

Fig.2.14.A

Sheet2.6 Formula of Dimension D, G and H

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<td>G</td>
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H—protective height

①Emitter/Receiver  ②KS magnet-seat plate  
③KS magnet-seat  ④KS permanent magnet  
⑤M5×12 cross semicircle head screws, Φ5 elastic washer  
⑥T–nut  ⑦M6×12 inner hexagon screw, Φ6 elastic/plain washer

WARNING

To adopt this form of installation, it is necessary to have a staff responsible for the safety management; the installation position of AOPD must meet the requirements for safety distance and relative altitude height.
UNIT 3 WIRING

Make sure to perform wiring while the power supply of machine is OFF and the wiring is performed according to the wiring diagram strictly.
Properly perform the wiring after confirming the signal names of all terminals.
PE is the earth wire of AOPD, it must be connected well to the earth.
OSSD is forbidden to be connected into 380V circuit.

1 WIRING ABOUT CPSI CONTROLLER

CPSI controller provides switch mode power input.

1.1 Wiring about power cable

Power cable between controller and the electronic equipment of machine is 5-core, in which the terminal of controller is connected by 7-core socket connector.

At the time of wiring, connect to the correct power supply according to the numerical values marked on the nameplate.

---

Fig3.1.A Single-side protection
1.2 Wiring about OSSD1

OSSD1 are the control lines. They are the output signal contact of AOPD, normally open contact. They should be connected to the stop control loop of machine stroke. The wire terminals marked with OSSD1 should be connected according to the form of connection shown in Fig3.2.

<table>
<thead>
<tr>
<th>Light curtain state</th>
<th>Indicators of receiver</th>
<th>Indicators of CPSI controller</th>
<th>Output signal state of OSSD1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Green status indicator</td>
<td>Red status indicator</td>
<td>Normal operation indicator</td>
</tr>
<tr>
<td>Unblocked</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Blocked</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>

The declaration of using normally closed (NC) contacts:

The customer should make special order if they want to use NC contacts as the control connects.

If NC contacts must be used for special purpose, it is ensured that they must be connected reliably with the stop control loop of machine stroke. The maintenance should be carried out besides control function of AOPD being checked routinely by the operators. The condition of all the contact junctions with NC contacts must be checked monthly to ensure that they are connected reliably. Our company will not be responsible for the accident caused by improper wiring of NC contacts.
I.3 Realization of muting function
1. If the muting function is realized by machine itself, no additional wiring is needed;
2. If the muting function is realized with the help of AOPD, connect one pair of normally open contact points of cam switch with OSSD1 in-parallel, as shown in Fig3.3.

![Cam Switch Diagram](image)

**Fig3.3 The muting function is realized by OSSD1**

### WARNING
In general, NC contacts should not be used as the control contact for safe purpose!
Our company will not be responsible for control failure resulted by poor contact or disconnection of the circuit.
Other safety measurements must be adopted when NC contacts have to be connected into the circuit.

To avoid an accident, the cam switch must be adjusted to the right angle!

The transmission cables between CPSI controller and emitter/receiver are both 5-core. The two terminals of transmission cable are all connected by multipin connector with the way of threaded connection.

### NOTICE
To avoid strength created by strain and damage of connector, the cable close to the side of connector should be relaxed properly when it is tightened after the completion of wiring. See Fig3.8.

II WIRING ABOUT CQ1 CONTROLLER
CQ1 controller provides switch mode power input.

II.1 Wiring about power cable
The power cable between controller and the electronic equipment of machine is 5-core; the terminal of controller is connected by 12-core connection terminals.

At the time of wiring, connect to AC100V to 230V power supply according to the numerical values marked on the nameplate, see Fig3.4.A, or connect to DC24V power supply (free polarity), see Fig3.4.B.

II.2 Wiring about OSSD1
Refer to the connection form of CPSI.
Fig 3.4.A AC100V to 230V power supply

Fig 3.4.B DC24V power supply
II.3 About OSSD3
In general, OSSD3 should not be used as the control contact for safe purpose! If OSSD3 are needed, take out the overload fuse F1/5A first.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>If customer insists using OSSD3 to control operating stroke of machine tool slide, our company will not be responsible for control failure resulted by poor contact or disconnection of the circuit.</td>
</tr>
</tbody>
</table>

II.4 Realization of muting function
The realization of muting function, refer to the connection form of CPSI controller.

II.5 Wiring about CQ1 controller and emitter/receiver
The transmission cables between CQ1 controller and emitter/receiver are both 5-core. The terminals of transmission cable are 12-core and the terminals of emitter/receiver are connected by multipin connectors.

At the time of wiring, connect the terminals of transmission cable with the correspondingly terminals of the CQ1 controller according to the wire markings, fasten the compression-joint screw, and then connect the transmission cable with the emitter and receiver.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>To avoid strength created by strain and damage of connector, the cable close to the side of connector should be relaxed properly after the completion of wiring. See Fig3.8.</td>
</tr>
</tbody>
</table>

III WIRING ABOUT JKIII INTERFACE
The input of JKIII interface is commonly DC24V, and the transistor conducts when the light curtain is in the light-passing state. If the customer has the special requirement, select the proper interface according to Sheet1.6 and Sheet4.2, and make a proposal at the time of placing order.

The JKIII interface is connected to the power cable by a 5-core cable, the terminal of JKIII interface is 5-core terminal.

III.1 Wiring about power cable
The wiring refers to Fig3.5.

- DC24V and DC0V is the power supply input terminal, the power supply should be coupled in according to the marked value.
- OSSD1 and OSSD2 are two terminals of output control signal, should be connected to the stop control loop of machine stroke.
- “PE” is the terminal of protective earthing terminal.

III.2 Wiring about JKIII interface and emitter/receiver
The transmission cables between JKIII interface and emitter/receiver are both 5-core. The terminals of transmission cable are 12-core and multipin connectors. Transmission cable and JKIII interface are connected by 12-core terminal, and transmission cable and emitter/receiver are connected by multipin connectors.

At the time of wiring, connect the terminals of transmission cable with the correspondingly termi-
nals of the JKIII interface according to the wire markings, fasten the compression–joint screw, and then connect the transmission cable with the emitter and receiver.

Fig3.5.A NPN output

Fig3.5.B PNP output

To avoid strength created by strain and damage of connector, the cable close to the side of connector should be relaxed properly after the completion of wiring. See Fig3.8.
IV  WIRING ABOUT KS02HG SAFETY LIGHT CURTAIN

Power supply of the safety light curtain is DC24V, it can output transistor control signal directly. Wirings about the NPN and PNP output are shown in the following figure. For the emitter, the line of 24V+, OSSD1 and OSSD2 should not be connected.

![Fig3.6.A NPN output](image1)

![Fig3.6.B PNP output](image2)

V  ASSEMBLY ABOUT CONNECTOR

According to Fig3.7:

- At the time of assembly, use the plug for insertion, the plug key tallies the groove, jogs the end of plug, then fasten the cage nut clockwise.
- At the time of disassembly, loosen the cage nut anticlockwise, and then pull the plug out.

![Fig3.7 Schematic illustration of assembly and disassembly department](image3)

![Fig3.8 Method of fixing cables](image4)
UNIT 4 DEBUGGING

After wiring, make a detailed check according to nameplate markings and operation manual to ensure that all the connections are correct; the power supply can be switched on for debugging after the verification of wiring.

I THE DEBUGGING OF AOPD

I.1 Turn off the power switch, and then energize the machine (all the indicators are off). Check the power voltage with multimeter, the value must be in line with the voltage marked on the nameplate (voltage fluctuation range must not exceed ±15%).

I.2 For CPSI controller, turn on the power switch, the orange power indicator is on;
For CQ1 controller, turn on the power switch, the orange power indicator is on;
For JKIII interface, program the machine control system, such as PLC system, the red power indicator is on when energize the machine.

I.3 Beam focusing

Turn on the power switch and turn the function switch to the protection side.
Adjust the positions of emitter and receiver, make them parallel, corresponding and aligned, until the red status indicator of receiver is off, the green status indicator of receiver is on.

I.4 Test

Shade the light curtain beam by beam. On the receiver, the red status indicator is on, and the green status indicator is off. On the controller, the green normal operation indicator is off; the red unusual station indicator is on;

When the light curtain is unblocked, on the receiver, the red status indicator is off, the green status indicator is on. On the controller, the green normal operation indicator is on, the red unusual station indicator is off, and AOPD is on–state.

For KS02HG safety light curtain and AOPD with JKIII interface, the normal output states are shown in the Sheet 4.1 and Sheet 4.2.

I.5 Ensure that the safety distance and relative altitude height are both correct.

I.6 Fasten all the installed screws on AOPD firmly.

Sheet 4.1 Operating state of KS02HG safety light curtain

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>KS02HB□□□□G–2NT</td>
<td>Unblocked</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>KS02HB□□□□G–2NZ</td>
<td>Blocked</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>KS02HB□□□□G–2PT</td>
<td>Unblocked</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>KS02HB□□□□G–2PZ</td>
<td>Blocked</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>KS02HB□□□□G–2PZ</td>
<td>Unblocked</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>KS02HB□□□□G–2PZ</td>
<td>Blocked</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>
II ANGLE ADJUSTMENT OF MUTING FUNCTION

If muting function needs to be realized, the angle of cam can be adjusted according to the situation shown in Fig4.1 on the premise of safety. In the case that muting function is realized with the help of AOPD, the state of muting function is shown in Sheet4.3.

![Fig4.1 Structure & functional mode of cam switch](image)

Sheet4.2 Operating state of JKIII interface

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Power (red)</td>
<td>Driving Signal (green)</td>
<td></td>
</tr>
<tr>
<td>JKIII-□□□24-2NT</td>
<td>Unblocked</td>
<td>ON</td>
<td>ON</td>
<td>300mA, DC0V to 4V</td>
</tr>
<tr>
<td></td>
<td>Blocked</td>
<td>ON</td>
<td>OFF</td>
<td>OPEN, (DC24V, drain current&lt;2mA)</td>
</tr>
<tr>
<td>JKIII-□□□24-2NZ</td>
<td>Unblocked</td>
<td>ON</td>
<td>OFF</td>
<td>OPEN, (DC24V, drain current&lt;2mA)</td>
</tr>
<tr>
<td></td>
<td>Blocked</td>
<td>ON</td>
<td>ON</td>
<td>300mA, DC0V to 4V</td>
</tr>
<tr>
<td>JKIII-□□□24-2PT</td>
<td>Unblocked</td>
<td>ON</td>
<td>OFF</td>
<td>OPEN, (DC0V, resistance to ground 10K)</td>
</tr>
<tr>
<td></td>
<td>Blocked</td>
<td>ON</td>
<td>OFF</td>
<td>OPEN, (DC0V, resistance to ground 10K)</td>
</tr>
</tbody>
</table>

Sheet4.3 State of muting function

<table>
<thead>
<tr>
<th>Method of connection</th>
<th>State of light curtain</th>
<th>State of receiver</th>
<th>State of controller</th>
<th>State of stop control loop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected with OSSD1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closing</td>
<td>Unblocked</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>Blocked</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Opening</td>
<td>Unblocked</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td></td>
<td>Blocked</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

WARNING

The adjustment of cam angle determines the non-protection area of machine, which matters the personnel safety, please be cautious!
III COMMISSIONING

After debugging, commissioning should be carried out to ensure the AOPD is absolutely risk-free in operation.

III.1 Block the light beams of light curtain, observe indicators of AOPD, and check if the conversion of indicators is correct.

III.2 For presses on which the slider can stop at any point in one stroke, in the protection interval—as for the machine with muting function, the cam switch of muting function is in opening status from 30° to 180° of stroke down—block the light curtain, the machine slider will stop at once.

For presses on which the slide can stop at any point in one stroke, the braking must not have any failure!
If the braking is at fault, the machine must be repaired at once!
If the braking of machine is at fault, the AOPD can not offer personnel protection!

For presses which can only realize upper dead point protection, when the slider is at the upper dead point, shade the light curtain, the next stoke is not able to start up.

For presses which can only realize upper dead point protection, the machine can not have the clutch failure!
If the clutch of machine has failure, the machine must be repaired!
If the clutch of machine has failure, the safety of AOPD is at risk!

III.3 When the slider is at the lower dead point, block the light curtain, the slider of machine should be able to return.

If III.1, III.2, III.3 above are all met, the debugging of AOPD is successful, and it can be put in use.
UNIT 5 OPERATION, CHECK AND MAINTENANCE

I OPERATION

● Before operating the machine, check the AOPD control function to the machine slider, as shown in III COMMISSIONING, UNIT 4 DEBUGGING.
● For safe purpose, the key of function switch of CPSI controller must be kept by special staff.
● The position of light curtain should not be changed at will.
● The safety distance and relative altitude height of AOPD must be adjusted by the special staff after changing the die.
● When failure of AOPD occurred, it should be repaired by the professional staff.
● When the AOPD and the transmission cables are being disassembled, at first switch off the power supply, this must be operated by the special staff.
● The performance life of relay inside the controller is $10^6$ times, it should be changed when it reaches the performance life.

If the misty opacity occurred inside the relay, the relay must be changed.

● When the AOPD is not in use,
  for CPSI controller, turn the function switch to the non–protection side;
  for CQ1 controller, turn on the power switch, turn the function switch to the non–protection side.

### NOTICE

At this moment, the AOPD can not protect any more, other safety prevention measures should be adopted.

● During use, prevent the AOPD from collision caused by work piece, tool, scrap.
● If the controller is equipped with reset button, after light shading, the machine slider couldn’t run or start up again until the AOPD is reset by pressing the reset button.

### WARNING

When the AOPD is not in use, other safety prevention measures should be adopted.

### WARNING

Hot plugging for power cable is forbidden!
II  CHECK AND MAINTENANCE

The check and maintenance of AOPD is very important to ensure the protection of punching operation, the AOPD must be checked and maintained regularly to give full play to its function. See Sheet5.1 for detailed requirements of check and maintenance.

Sheet5.1

<table>
<thead>
<tr>
<th>Projects</th>
<th>Details</th>
<th>Methods</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>Filter plate</td>
<td>Make sure the light filter surface is clean and unbroken</td>
<td>Before operating</td>
</tr>
<tr>
<td></td>
<td>beams block the detecting</td>
<td>Block each beam of the light curtain; observe the indicators of receiver and controller</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Effective protection scope</td>
<td>For the machine with the muting function realized by the cam switch, block the light curtain during 30° to 180° of the cam switch trip, the slider of machine will stop at once</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fasteners</td>
<td>Fasten all the screws</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connection terminals</td>
<td>Make sure the cage nuts are not loosened, the lead contact is all right</td>
<td>Six months</td>
</tr>
<tr>
<td></td>
<td>Relay</td>
<td>Make sure the installation of relay is solid, the contact is all right, the movement is normal; observe the relay to make sure there is no misty opacity phenomena inside it</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>Replacement of relay</td>
<td>It must be fixed firmly after the replacement</td>
<td>Misty opacity occurred inside the relay or the performance life has reached 10&lt;sup&gt;6&lt;/sup&gt; times</td>
</tr>
<tr>
<td></td>
<td>Cleaning of light filter surface</td>
<td>Clean it with a clean and soft cotton yarn bedewed with alcohol (organic solvent is banned from using)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement of the filter surface</td>
<td>If it is broken, it should be replaced at once</td>
<td>Carry on according to the operational situation</td>
</tr>
<tr>
<td></td>
<td>Tightening and replacement of fasteners</td>
<td>Fasten the loosened fasteners, fasteners with the broken sliding–filament must be replaced at once</td>
<td></td>
</tr>
</tbody>
</table>

Apart from regular checks, it is necessary to check AOPD before each operation.

⚠️ WARNING  Hot plugging for power cable is forbidden!
## UNIT 6 TROUBLESHOOTING OF SIMPLE FAILURE

### I DISTINGUISHING OF AOPD AND MACHINE

#### Sheet 6.1

<table>
<thead>
<tr>
<th>Phenomena</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>AOPD could not work, all the indicators are off</td>
<td>No supply voltage</td>
<td>Couple in correct power supply</td>
</tr>
<tr>
<td></td>
<td>Controller failure</td>
<td>Refer to Sheet6.2</td>
</tr>
<tr>
<td>AOPD works intermittently, the conversion of indicator is abnormal</td>
<td>Low or incorrect supply voltage</td>
<td>Couple in correct power supply</td>
</tr>
<tr>
<td></td>
<td>Bad beam focusing for AOPD or critical beam focusing</td>
<td>Readjust the position of emitter/receiver to make beam focusing all right</td>
</tr>
<tr>
<td>The conversion for indicator of AOPD is normal, press is not able to work</td>
<td>The connection between OSSD signal cable of AOPD output terminal and electric part of machine cut or incorrect</td>
<td>Check the electric circuit of machine connected with NO contacts, if the wiring is correct, replace or restore power cable</td>
</tr>
<tr>
<td></td>
<td>Electric failure of machine</td>
<td>Check and repair electric circuit of machine</td>
</tr>
<tr>
<td></td>
<td>Controller failure</td>
<td>Refer to Sheet6.2</td>
</tr>
<tr>
<td>The conversion for indicator of AOPD is normal, shade the light curtain, the press does not stop at once</td>
<td>The electric circuit of machine connected with NO contacts short circuit</td>
<td>Check and repair the electric circuit of machine connected with NO contacts</td>
</tr>
<tr>
<td></td>
<td>The circuit of cam switch for muting function is short circuit</td>
<td>Check and repair the circuit for muting function</td>
</tr>
<tr>
<td></td>
<td>The clutch of machine is at fault</td>
<td>Check the machine</td>
</tr>
<tr>
<td>The conversion for indicator of AOPD is normal, shade the light curtain, the press does not stop immediately</td>
<td>The adjustment of cam switch for muting function is incorrect</td>
<td>Check the machine or adjust the cam switch to the correct angle</td>
</tr>
<tr>
<td></td>
<td>The clutch of machine is at fault</td>
<td>Check the machine</td>
</tr>
<tr>
<td>Turn the function switch to the non-protection side, press is not able to work</td>
<td>The electric circuit of machine connected with NO contacts is broken</td>
<td>Check and repair the electric circuit of machine connected with NO contacts, if the wiring is correct then replace or restore the power cable</td>
</tr>
<tr>
<td></td>
<td>The loop of electric stroke for machine disconnects</td>
<td>Check and repair electric circuit of machine</td>
</tr>
<tr>
<td></td>
<td>Controller fault</td>
<td>Refer to Sheet6.2</td>
</tr>
<tr>
<td>Turn the function switch to the protection side, press is not able to work; turn the function switch to the non-protection side, press work normally</td>
<td>Controller fault</td>
<td>Refer to Sheet6.2</td>
</tr>
<tr>
<td></td>
<td>Emitter or receiver fault</td>
<td>Refer to Sheet6.3</td>
</tr>
</tbody>
</table>

Note: All the phenomenon shown in the above sheet takes place at a time when power switch is turned on.
## II TROUBLESHOOTING OF CONTROLLER

### Sheet 6.2

<table>
<thead>
<tr>
<th>Phenomena of failure</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The AOPD does not work, all the indicators are off</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No supply voltage</td>
<td>Couple in correct power supply</td>
<td></td>
</tr>
<tr>
<td>The power fuse fusing</td>
<td>Replace the power fuse with a new one of the same specification, 5×20/1A</td>
<td></td>
</tr>
<tr>
<td>Power cable failure or bad contact for socket connector</td>
<td>Check and repair power cable and socket connector</td>
<td></td>
</tr>
<tr>
<td>Power switch broken or bad contact for connector, or relevant circuits broken</td>
<td>Replace power switch, or check and repair relevant circuit</td>
<td></td>
</tr>
<tr>
<td>The switch mode power is broken</td>
<td>Check the circuit and switch mode power, replace the switch mode power if the wiring is correct</td>
<td></td>
</tr>
<tr>
<td><strong>The conversion for indicator of AOPD is normal, press is not able to work</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The fuse F1 fusing</td>
<td>Replace the power fuse with a new one of the same specification, 5×20/5A</td>
<td></td>
</tr>
<tr>
<td>The control output circuit breaks</td>
<td>Check and repair the circuit and wiring between OSSD</td>
<td></td>
</tr>
<tr>
<td>The contact point of relay is ageing or broken</td>
<td>Replace the relay with the same specification one</td>
<td></td>
</tr>
<tr>
<td><strong>Turn the function switch to the non-protection side, press is not able to work</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For CPSI, function switch is broken or related circuit failure</td>
<td>Check the circuit of function switch, if there is no fault, replace the controller</td>
<td></td>
</tr>
<tr>
<td>For CQ1, function switch or relay failure, the load fuse fusing</td>
<td>Check the load fuse or relay, if there is no fault, replace the controller</td>
<td></td>
</tr>
<tr>
<td><strong>The power indicator and unusual station indicator are on; the normal operation indicator is off</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The green status indicator of receiver is off</td>
<td>Emitter or receiver fault</td>
<td>Refer to Sheet 6.3</td>
</tr>
<tr>
<td>Wiring failure of transmission cables or transmission cable fault</td>
<td>Check and repair the transmission cable, if it’s broken, replace it</td>
<td></td>
</tr>
<tr>
<td>S signal line of transmission cable loose contact</td>
<td>Check the connection for S signal line</td>
<td></td>
</tr>
<tr>
<td>The relay fault</td>
<td>Replace the relay with the same specification one</td>
<td></td>
</tr>
<tr>
<td>The controller fault</td>
<td>Replace the controller with the same specification one</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** All the phenomenon shown in the above sheet takes place at a time when power switch is turned on.
III TROUBLESHOOTING OF Emitter/Receiver

Sheet6.3

<table>
<thead>
<tr>
<th>Phenomena</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>All the indicators of emitter or receiver are off</td>
<td>Transmission cable fault</td>
<td>Check and repair transmission cable and the wiring</td>
</tr>
<tr>
<td></td>
<td>Emitter or receiver fault</td>
<td>Replace emitter or receiver with of the same specification one</td>
</tr>
<tr>
<td>The red status indicator of receiver is on, the green status indicator is off</td>
<td>Bad beam focusing</td>
<td>Make the beam focusing well</td>
</tr>
<tr>
<td></td>
<td>The filter plate surface of emitter or receiver is dirty.</td>
<td>Wipe it with a clean, soft cotton yarn</td>
</tr>
<tr>
<td></td>
<td>Emitter or receiver fault</td>
<td>Replace emitter or receiver with the same specification one</td>
</tr>
</tbody>
</table>

IV TROUBLESHOOTING OF JKIII INTERFACE

Sheet6.4

<table>
<thead>
<tr>
<th>Phenomena</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>All indicators are off</td>
<td>No power supply</td>
<td>Check power supply and its wiring</td>
</tr>
<tr>
<td></td>
<td>JKIII fault</td>
<td>Replace the interface with the same specification one</td>
</tr>
<tr>
<td>The red power indicator is on, conversion of driving signal indicator is abnormal</td>
<td>Emitter or receiver fault</td>
<td>Refer to Sheet6.3</td>
</tr>
<tr>
<td></td>
<td>Bad beam focusing</td>
<td>Make the beam focusing well</td>
</tr>
<tr>
<td></td>
<td>Transmission cable fault or wiring fault</td>
<td>Check and repair transmission cable</td>
</tr>
<tr>
<td></td>
<td>JKIII fault</td>
<td>Replace the interface with the same specification one</td>
</tr>
<tr>
<td>The conversion of all indicators is normal, no output signal.</td>
<td>JKIII fault</td>
<td>Replace the interface with the same specification one</td>
</tr>
<tr>
<td></td>
<td>Power cable fault or wiring fault</td>
<td>Check and repair power cable</td>
</tr>
</tbody>
</table>

If you can not remedy the fault with the help of information provided in this chapter, please contact the manufacturer or the local "SDKELI" representative directly.