



# User Manual

## Handheld Welder

P/N: 11070XXXX

Model: YLPS-Weld-1500/2000-A

Ver: V2.01

Date: 20240329

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**Before using this product, please read the user manual carefully and familiarize yourself with the relevant content we have compiled for you. Please keep the user guide together with the product to provide you and all other users with operational, safety, and other important information at all times.**

### **Note:**

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**This guide is intended for users who are responsible for welding in industrial and non-industrial installations.**

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## Safety Information

### Safety Convention

We will use different words and characters to remind you of a variety of potential hazards and important information, including:

#### WARNING



Be applicable to a variety of potential personal injuries. This signal reminds you that you need to follow the specified use methods or steps to use, and if you do not follow the prompts to operate correctly, it may cause personal injury to yourself or others. If you do not fully understand and meet the required conditions, do not negotiate the WARNING symbol to continue to the next step.

#### CAUTION:



Be applicable to potential product damage. The signal reminds you that you need to follow the specified use methods or steps. If you do not follow the prompts to operate correctly, it may cause damage to the product or parts. If you do not fully understand and meet the required conditions, do not negotiate the CAUTION symbol to continue to the next step.

#### IMPORTANT:



Various information about the usage of this product. Please do not ignore this information.

#### WARNING



This symbol represents laser radiation. This symbol appears on products with laser output.

## **Safety Guidance**

In order to ensure safe operation and optimize the operational performance of this product, please strictly comply with the following WARNING and CAUTION, as well as other information contained in this manual.

### **WARNING:**

When using this product, make sure to use the appropriate ground power supply.

### **WARNING:**

Any parts inside this product are not allowed to be opened by the user for maintenance. If necessary, please contact GW Laser technicians for maintenance services. Any unauthorized alteration to this product will void the warranty.

### **WARNING:**

The output connector of this product is connected by optical fiber cable and handheld welding connector. Please use the handheld welding head with care.

### **WARNING:**

If this product is used in a manner not specified in this document, the protection provided by the product may be impaired. This product must and should only be used under normal conditions.

### **CAUTION:**

Do keep the AC power supply off when operating the laser welding output connector (e.g., installing the cable connector, checking the end surface of the connector with an optical instrument, filling the wire, etc.).

### **WARNING:**

Never look directly at the fiber output connector, and be sure to wear proper protective goggles to avoid injury when using laser products.

### **CAUTION:**

Performing operations or adjustments outside the scope specified in this manual may result in radiation

## Laser Class

In accordance with 21 CFR 1040.10 and 1040.11 under IEC/EN 60825-1, this product is a high power class-4 laser. This product can output up to 2000W of non-visible infrared light. The laser of such class may cause eye or skin injury. Although the output light is invisible, it can still cause irreversible corneal damage. This product does not provide a laser safety protective goggles, but it is necessary to wear suitable protective goggles to avoid injury when using the laser.



### WARNING:

Never look directly at the fiber output connector, and be sure to wear proper protective goggles to avoid injury when using the laser.

### WARNING:

The air-cooled handheld laser welding system is of a class-4 laser product. It can emit an invisible laser of up to 2000W at wavelengths between 900nm and 1100nm.

### WARNING:

Do not open the laser as there is not product parts or accessories to be used by the users provided inside the laser. All maintenance and repair of the products can only be carried out by the service personnel authorized by GW Laser.

### CAUTION:

Performing operations or adjustments outside the scope specified in this manual may result in radiation

## **Use environment and precautions**

### **WARNING:**

When using this product, be sure to use the appropriate grounding power supply and normal voltage.

### **CAUTION:**

Before starting the laser product, ensure that the ambient temperature and humidity are within the specified range.

### **CAUTION:**

Do not expose the product to excessive moisture.

### **CAUTION:**

The laser is in air-cooled mode. Please make sure that the ambient air is dry and clean;

### **CAUTION:**

Operation or adjustment beyond the scope specified in this manual may result in dangerous radiation injury.

### **CAUTION:**

Keep the output welding head clean. After each use, please close the protective cover. Do not touch the welded head lens with your hands, and do not use any solvents to clean the lens. As to the necessary lens cleaning and maintenance, be sure to use lens wiping paper.

## Table of Contents

|   |    |
|---|----|
| 1. Overview .....   | 8  |
| 1.1 Introduction .....  | 8  |
| 1.2. Application .....  | 8  |
| 1.3. Testing and Certification .....  | 8  |
| 1.4. Explanation of Packaging and Disassembly .....                         | 8  |
| 2. Laser Product Safety Information .....                                   | 10 |
| 2.1 Laser Product Safety Performance and Convention .....                   | 10 |
| 2.2 Relevant Regulations and Standards .....                                | 12 |
| 2.3 Laser Welding Protection .....  | 13 |
| 2.4 Welding Safety and Potential Hazards .....                              | 13 |
| 2.5 Electrical Safety .....   | 15 |
| 2.6 Environmental Safety .....  | 15 |
| 3.1 Handheld Laser Welding System Performance Parameters .....              | 17 |
| 3.2 Accessories .....   | 17 |
| 3.3 YLPS/YLIS-Series Welding Outfit Facade .....                            | 18 |
| 3.4 Schematic Diagram of Product Appearance Interface .....                 | 19 |
| 3.5 Schematic Diagram of Handheld Welding Head .....                        | 20 |
| 3.6 Product Layout and Dimensions .....                                     | 21 |
| 4. Welding Equipment Installation .....                                     | 23 |
| 4.1 Preparation Before Installation .....                                   | 23 |
| 4.2 Air Flow and Installation Gap .....                                     | 24 |
| 4.4 Welding Auxiliary Gas Connection .....                                  | 25 |
| 4.5 Handheld Welding Head Cable Connection .....                            | 26 |
| 4.6 User Interface .....  | 26 |
| 4.7 Power Supply Connection .....   | 28 |
| 4.8 System Startup and Shutdown .....                                       | 28 |
| 5. Laser Welding System Operation .....                                     | 30 |
| 5.1 Control Panel Operation .....   | 30 |
| 5.2 Welding Head Usage and Operation .....                                  | 31 |
| 5.3 Important Safety Functions .....  | 33 |
| 5.4 Begin Welding .....   | 34 |
| 6. User Interface Function Introduction and Process Parameter Setting ..... | 36 |
| 6.1 Introduction to the Menu Structure of User Interface .....              | 36 |
| 6.2 Usage of User Interface Status Page .....                               | 37 |
| 6.3 Usage of User Interface Control Page .....                              | 39 |
| 6.4 Equipment Page Information View .....                                   | 48 |

|   |    |
|---|----|
| 6.5 Recommended User Parameter Setting .....                  | 48 |
| 6.6 Recommended Welding Parameters for Common Materials ..... | 49 |
| 7. Troubleshooting/Maintenance .....                          | 51 |
| 7.1 Error Message and Troubleshooting .....                   | 51 |
| 7.2 Welding Head Maintenance and Replacement .....            | 53 |
| 8. Warranty .....   | 54 |
| 8.1 General Warranty .....                                    | 54 |
| 8.2 Service and Repair .....                                  | 54 |
| 8.3 Change .....  | 55 |

# 1. Overview

## 1.1 Introduction

YLPS/YLIS series handheld fiber laser welding system is a new industrial-grade handheld infrared optical fiber laser welding system. Its maximum continuous wave power is  $\geq 2000\text{W}$  in continuous mode, and the average power in pulse mode is  $\leq 2000\text{W}$ .

The built-in Blade series fiber lasers of GW handheld laser welding system are specially designed for purpose of industrial material processing applications and feature the most reliable and efficient ABR and SPP proprietary technologies. Key innovations in the BLADE series fiber lasers also include the proprietary thermal processing, mode-filtering technology, and a durable and novel fiber laser structure. The BLADE fiber laser includes a powerful optical engine, comprehensively controlling and monitoring the electronic equipment. The beam is transmitted and output through a metal-protected QBH optical fiber cable.

The Blade series lasers provide up to 2000W continuous wave (CW) single-mode laser output, with the output band between 1070nm and 1080nm. BLADE lasers provide high-efficiency and high-quality laser output. The beam quality M2 output from a single-mode fiber cable is less than 1.2 at best, or in case of high-brightness multi-mode fiber cable output, BPP < 1.5. Such output options of higher beam quality and multi-mode fiber cable make this product ideal for handling a variety of materials, like the fine cutting, precision welding, and cutting and welding of different materials with different thicknesses.

GW Handheld laser welding systems are designed and tested with safety in mind. By following this user guide and applying laser safety measures, it can be a safe and reliable equipment.

To ensure the safe operation and optimal performance of the product, please follow the use warnings and other information contained elsewhere in this document. These safety precautions must be observed at all stages of the operation, maintenance and repair of the instrument.

## 1.2. Application

The YLPS/YLIS series handheld laser welding system is applicable for industrial and professional use. The application fields include welding and brazing. Materials include steel, aluminum, copper, stainless steel and other metal materials.

## 1.3. Testing and Certification

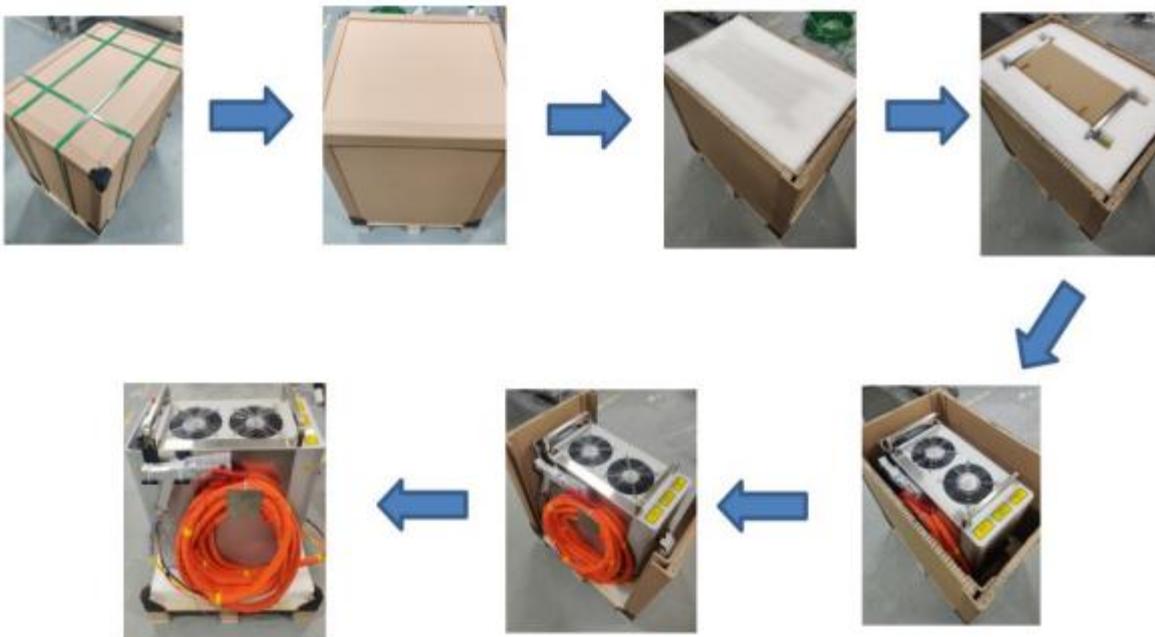
GW certifies that this system has been thoroughly tested and inspected. Before packing, it is fully inspected and verified to meet the shipping standards. When you receive the equipment, please check the packaging and components for any damage that may have occurred during transportation. In case of obvious damage, please contact the carrier and GW after-sales personnel immediately;

## 1.4. Explanation of Packaging and Disassembly

If there are any signs of damage to the external packaging, please check whether the equipment is damaged or not, and immediately notify the carrier and GW after-sales personnel; When you take out this system from the packing case, you must take special care to ensure that the fiber optic cable is not broken or damaged; Please check the attached packing list. Once the product is received, be sure to check all items with this list, and do not under any circumstances attempt to install or operate the laser equipment if any items are missing or the equipment has obvious or suspected damage.

To reduce the risk of product damage, GW recommends that you can turn on your air-cooled handheld laser welding system by following the following procedure;

- 1.4.1 Use a forklift with power source to move the whole packing case to the unpacking position;
- 1.4.2 Remove the top honeycomb panel cover and top EVA (white foam); Note: The welding head is packed inside the EVA;
- 1.4.3 Fix the cables and outer case with fiber cable ties. The welding head is wrapped as well. It is recommended by GM that cutting tools should be used for disassembly;
- 1.4.4 Place the dismantled welding head on the top of the equipment. Do not pull or bend the wire cable. Do not attempt to hoist the equipment by using the attached cable ties or wire cables;
- 1.4.5 Remove side panels from the packing case. Take out the product from the packing case, and use the two handles on the top of the product. Two person are recommended by GM for lifting the equipment at all times. Be careful when operating the cable ties and welding head.
- 1.4.6 Check the attached details according to the items listed on the packing list;
- 1.4.7 Retain all packaging for future transportation or storage;



**Do not use the cable accessories that are attached to the product to lift or locate the equipment. Pay attention to the anti-tilt label. Do not transport or use the tilted equipment.**

## 2. Laser Product Safety Information

### 2.1 Laser Product Safety Performance and Convention

To ensure the safe operation and optimal performance of the product, please follow all warnings in this guide. Safety precautions must be observed at all stages of operation, maintenance and service. Operators must adhere to these recommendations and apply sound laser safety practices at all times. Never open the module. There are no user serviceable parts, equipment or assemblies associated with this product. All internal service and maintenance shall be carried out only by qualified GW after-sales personnel;

This user guide uses a variety of words and symbols that are intended to alert you to pay attention to possible dangers or important information.

#### 2.1.1 Safety Performance

| Performance             | Description   |
|-------------------------|---|
| Output power monitoring | Monitor the output power while the laser is operating.  |
| Overheat protection     | Monitor the internal temperature of the laser to protect the internal components from damage due to exceeding the safe operating temperature. |
| Safety/warning labels   | Various labels are used to alert and warn users of possible hazards.  |

#### 2.1.2 Safety Labels

Safety labels and label location:

The following pictures show the labels and their position on the product.



#### Laser outlet label

Location: Rear panel/welding head



#### Certification label

Location: Rear panel



#### Warning label

Location: Rear panel/welding head



**Certification label**

**Location:** Rear panel



**Warning label**

**Location:** Rear panel/welding head



**Product lable**

**Location:** Rear panel



**Warning sign**

**Location:** Welding head



**Warning sign**

**Location:** Welding head



**Reminding sign**

**Location:** Welding head

## 2.2 Relevant Regulations and Standards

### 2.2.1 Product Function Safety

|                   |  |
|-------------------|--|
| Electrical Safety | EN 61010 - 1:2010                        |
| Laser safety      | EN 60825 - 1:2010<br>CDRH 21 CFR 1040.10 |

Optical fiber cable protection disconnection (optical fiber interlock): The optical fiber protects the loop for the fiber laser to interlock with an external device (such as a handheld welding head). The laser welding system will continuously monitor this signal and terminate the working of external device (such as a welding head) if the optical fiber connector is not connected correctly.

The said handheld laser welding system provides a protection signal output based on wire cables contained in the fiber optic cable between the laser equipment and the handheld welding head. If the fiber optic cable is not inserted into the welding head or disconnected, the fiber cable security interlock loop will open.

Guarantee of stop and start: Install various electronic sensors inside the system, and if any abnormal conditions are detected, the monitoring program will alarm, and the system will stop continuing to start;

Safety start/restart button (scram) : Used for emergency shutdown and recovery of laser welding systems.

Key switch: Start/turn off the main loop power supply of laser welding system.

### 2.2.2 Laser Products Classification

According to the requirements of governmental and industry standards, all lasers are classified based on their output power or energy and laser wavelength.

According to IEC/EN 60825-1, this product belongs to the high-power class-4 laser. This product can output up to 2000W invisible infrared light. The laser of such class may cause eye or skin injury. Although the output light is invisible, it can still cause irreversible corneal damage. This product does not provide laser safety protective goggles. But be sure to wear suitable protective goggles to avoid injury when using laser products.

Class 4 - high power lasers present the most serious of all laser hazards. Take precautions to prevent injuries caused by accidental exposure to direct and reflected light.

Diffuse and specular reflections can inflict severe retina and/or cornea injuries leading to permanent eye damage. Class 4 laser beam is also a kind of potential fire hazard and skin hazard. All personnel must wear appropriate eyewear when operating the equipment. For information on the laser safety eyewear, see the section 2.2.3.

Use of controls, adjustments or performance of procedures other than those set forth in this user guide may result in exposure to hazardous radiation.

### 2.2.3 Laser Safety Eyewear

When operating this equipment, please wear appropriate laser safety eyewear. The selection of appropriate laser safety eyewear requires the end user to accurately identify the range of wavelengths emitted from this product.

Usually around the laser output aperture, there are many secondary laser beams of different angles generated. These beams are called as "specular reflections", which are produced from the reflection of laser when the main laser beams are emitted onto the surface. Although the power of such secondary

beams may be less than the total power of beams emitted by the laser, it is strong enough to cause damage to the eyes, skin, and the materials around the laser.

If the equipment is a tunable resonant laser or Raman product, it will emit laser in other wavelength ranges. End users should verify that the laser safety eyewear used are capable of protecting from the laser within the entire wavelength range that is emitted by the equipment.

Be careful to avoid/minimize specular reflections. This product emits invisible laser radiation at or around a wavelength of 1070nm (infrared). In addition, this product emits visible laser radiation at or around a wavelength of 600 - 700nm (infrared).

Please review the safety labeling on the product and verify that the personal protective equipment (i.e. enclosures, viewing windows, or viewports, eyewear, etc.) being utilized is adequate for the output power and wavelength ranges. Decisions on safety eyewear must also take into account any secondary radiation hazards due to the welding process

Laser safety eyewear must conform to international safety standards, including ANSI Z136.1 (the USA) and EN207/EN208/EN60825 (Europe). The regulations in force will depend on the location of the laser installation.



### 2.3 Laser Welding Protection

Eye protection is required during laser welding to protect your eyes from any reflected or scattered Class-4 laser beams, and also to protect from welding glare, ultraviolet rays, heat and sparks.

For laser welding, only wearing personal protective equipment against laser infrared wavelengths is not enough. A combination of a mask, helmet and/or goggles will provide the best protection during laser welding. For example, an additional welding helmet (with appropriate filter glasses) should also be worn over laser safety eyewear to protect the wearer from ultraviolet and visible light radiation. Welding helmets also protect welders from heat splash, metal particles and sparks. Therefore, personnel working near the laser welding area must wear personal protective equipment.

Exposure to infrared and ultraviolet radiation during welding can damage the skin. Depending on the intensity of the IR light, skin injuries may include thermal burns or excessive dry skin. Exposure to UV light may cause skin burns that are similar sunburns and will increase a welder's risk of skin cancer and accelerated signs of skin aging. Welding sparks may also cause burns.

Laser material processing can transfer a significant amount of energy to the part. Even after the cutting or welding process is complete, parts can be very hot. Ensure proper personal protective equipment is used to prevent potential burns. Wear protective clothing such as fire-resistant gloves, caps, leather aprons and other flame-resistant clothing to prevent skin damage. Sleeves and collars should be buttoned!

## 2.4 Welding Safety and Potential Hazards

### o 2.4.1 Fire Hazard

If there are combustible or flammable materials near the welding area, the heat and sparks generated during the welding process may cause a fire or explosion. Laser welding should only be performed if the area is free of combustible materials.

Do not weld on containers containing flammable or combustible materials. If the contents of a container are unknown, you should assume that they are flammable or combustible. Fire extinguishers should be nearby and easily accessible, and personnel should be trained to use them.



#### 2.4.2 Fume Hazard

Welding “fume” can be comprised of very fine particles and gases. Welding fumes and gases come from a combination of welding materials or any filling materials used, protective gases used, paints, coatings, chemical reactions and air contaminants. Welding fumes can adversely affect the lungs, heart, kidneys and central nervous system.

When the laser interacts with the target material (e.g. plastic, metal, composite materials), the target material may begin to evaporate. These fumes and particles are often invisible, but are highly toxic and pose a serious health hazard.

Welding in confined spaces with poor ventilation is very dangerous. The danger of toxic fumes and gases can rapidly increase, leading to coma or death by suffocation.

Ultraviolet light emitted during welding can react with oxygen and nitrogen in the air to form ozone and nitrogen oxides, which can kill people in high concentrations.

The protective gases used during welding can displace air and cause personal injury or death.

When welding, do not let your head come into contact with the gas. Be sure to weld in a well-ventilated area to ensure that the air you breathe is safe. Use a fume extraction system to remove vapors, particles and harmful debris from the welding processing area. Read and follow safety data sheets and warning labels for all welding materials used. Respirators may also be required in confined spaces and other situations. Routine air monitoring should be conducted to determine the levels of hazardous fumes in the welding area.



#### 2.4.3 Gas Cylinder Safety

The gas cylinder may explode if damaged or placed nearby to the welding area. Shielding gas cylinders should be located in areas where they cannot be struck or damaged. Place them away from sources of heat, sparks or flame. Gas cylinders must be stored upright and secured to a fixed bracket. A working regulator suitable for the required gas and pressure is required. All hoses and fittings should also be suitable for the application and kept in good working condition.



#### 2.4.4 Optical Safety

The laser output is delivered through a window or optionally a device with an anti-reflective coating. Make sure the windows are clean and of good quality. Any dust at the end of the head assembly can burn out the window and damage the laser. Check the quality of the light spot emitted by the laser output at low power, and then gradually increase the output power.

Never look directly at the laser aperture (such as fiber, collimator, or scanning head) while the start button or remote start circuit is activated. Always wear appropriate laser safety eyewear when handling the product. All personal protective equipment must be compatible with the output power and wavelength range listed on the laser safety label affixed to the product.

When power is supplied to the laser, do not look directly at the output port; Avoid positioning the laser and all optical elements at eye level; Avoid using lasers in dark environments; When using the output (such as

installing the laser head to the fixture), please turn the switch key to the OFF position; As a precautionary measure, during the operation of this product, please gradually increase the output power from low to high; Do not install the laser head when the laser is active.

Photosensitive components in devices, such as cameras, photomultiplier tubes and photodiodes, can also be damaged by exposure to lasers. The laser is powerful enough to burn skin, clothing and paint. Lasers can cut and weld metal. The laser can ignite volatile substances such as alcohol, gasoline, ether and other solvents. Installation and use must avoid contacting with solvents or other flammable materials and gases.



## 2.5 Electrical Safety

The input voltage of the laser can be lethal. All electrical cables and connections should be treated as if they were at a harmful level. All parts of the electrical cable, connector or equipment housing should be considered dangerous. Before supplying power to the equipment, check whether the wiring harnesses are damaged and whether the welding protective gas is on. In addition, where applicable, all connections must be secured with screws to ensure proper function.

Ensure that the equipment is grounded through the protection conductor of the AC power cable. If any PGND conductor is disconnected from the PGND terminal, personal injury may occur. In order to continuously prevent fire hazards, it is necessary to only replace with line fuses of the same type and rating (if applicable); The use of other fuses or other materials is prohibited; Before supplying power to the equipment, ensure that the used AC power supply voltage is correct. Incorrect voltage will cause equipment damage; Refer to the markings on the specific model for proper power connections; There are no operator serviceable parts inside; Assign all maintenance work to qualified GW after-sales personnel; To prevent electric shock, do not remove the cover; Any tampering with the product voids the warranty. In addition to the mains electricity connection, the external connection between this product and other external equipment is PELV(Protected extra-low voltage) as defined by IEC 61140. The non-mains electricity output of other devices connected to this product should also be PELV or SELV(safe extra-low voltage).

## 2.6 Environmental Safety

Do not dispose of this product with household waste. Electronic equipment must be disposed of in accordance with regional directives on the disposal of electronic and electrical waste. Note that all personal protective equipment must be compatible with the output power and wavelength range listed on the laser safety label affixed to the laser equipment. Be careful when operating, otherwise the laser may damage the equipment.

The equipment is suitable for : (1) indoor use; (2) use below 2000 meters above sea level; (3) overvoltage class II; and (4) drying place.

This equipment is not suitable for use in places where children may be present. Keep away from striking or vibration sources. An appropriate housing should be used to ensure a laser-safe working area. This includes, but is not limited to, laser safety signs, appropriate warning devices, and training/safety procedures. Do not operate the output welding head at eye level. Ensure that the laser shield is in place to protect the eyes of those working in the area from injury.

### 2.6.1 Humidity

Do not expose the equipment to a high-moisture environment (>90% humidity). (For details, see 3.1 Performance Parameters)

### 2.6.2 Cooling and Temperature

The handheld laser welding system is in air-cooled mode. Operating at higher temperatures will accelerate aging. Increase threshold current and reduce slant rate efficiency. If the equipment is overheated, do not use it. Call 400 for help from the after-sales personnel. When the ambient temperature exceeds 50°C, the equipment will automatically alarm and limit the operation of the equipment.

### 3. Description of Handheld Laser Welder

#### 3.1 Handheld Laser Welding System Performance Parameters

| Optical performance parameters                        |   |
|---|---|
| Output power (W)                                      | 1500W      2000W                                |
| Working mode  | Continuous/modulation/pulse/linear array/timing |
| Output power adjustment range (%)                     | 1-100%  |
| Output laser wavelength (nanometer)                   | 1070 ± 10 nm                                    |
| Power stability                                       | ±3%   |
| Maximum modulation frequency                          | 50kHz   |
| Laser response time                                   | < 10us  |
| Indication laser wavelength (nanometer)               | 650   |
| Indication optical power adjustable range (milliwatt) | <1mW  |
| Laser conduction system parameters                    |   |
| Interface type  | Wire feed-type handheld welding head            |
| Collimation focal length                              | 50mm  |
| Focusing focal length                                 | 150mm   |
| Transmission length                                   | Standard length 5±0.5m (or 10m, optional)       |
| Working requirements                                  |   |
| Cooling and protective gases                          | Insert gas                                      |
| Working ambient temperature range                     | -15 - 45°C                                      |
| Working ambient humidity range                        | ≤90 degree                                      |
| Input voltage   | 220VAC/50Hz/60Hz                                |
| Complete machine power                                | ≤ 4.8 kW/6.3KW                                  |

#### 3.2 Accessories

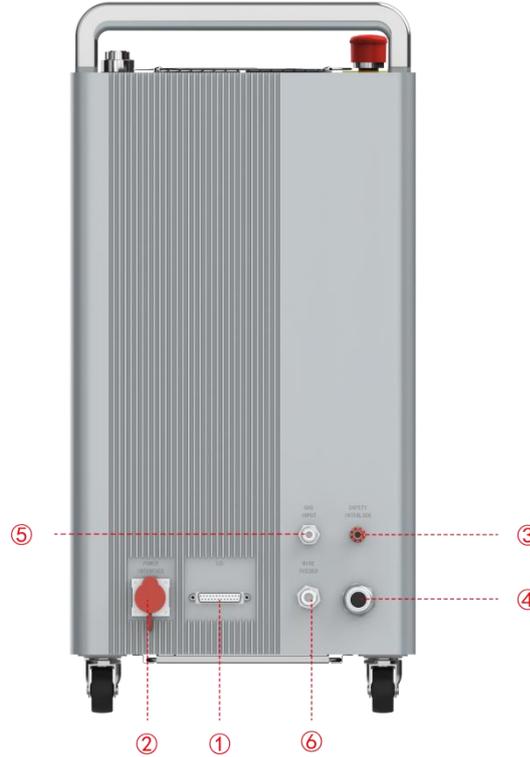
| Standard accessories                             |          |      |   |
|--|----------|------|---|
| Item   | Part No. | Qty. | Note  |
| User Guide for Handheld laser Welding System     | N/A      | 1    | Current document                                    |
| Power cable                                      | N/A      | 1    | Used for power on/off                               |
| Handheld welding head                            | N/A      | 1    |   |
| Welding nozzle (s)                               | N/A      | 1    | 8 types of nozzles                                  |
| Ground protection cable (choice of cable length) | N/A      | 1    | 5 meter-long wire cable or 10 meter-long wire cable |
| Other accessories available for purchase         |          |      |   |
| Welding helmet                                   | N/A      | 1    | Welding protective helmet                           |
| Wire-feed device unit                            | N/A      | 1    | Supplied by the third party                         |

### 3.3 YLPS-Series Welding Outfit Facade



| S/N | Name                   | Description   |
|-----|------------------------|---|
| 1   | Power key switch       | Turn the key knob clockwise to (ON) position to turn the power on, and turn the key knob counterclockwise to (OFF) position to turn the equipment off.<br>When the knob is in (ON) state, the key cannot be pulled out.   |
| 2   | Scram switch           | In case of an emergency, you can press the scram button down to quickly cut off the power supply of the main circuit of the equipment.<br>When pressing the stop button, turn the button clockwise to reset the scram button.                                       |
| 3   | Cooling fan            | When the equipment is running, the cooling fan will start or close according to the system command. During operation, the fan outlet position must not be blocked or be protected from foreign objects falling in   |
| 4   | Stainless steel handle | Used for the equipment movement and handling  |
| 5   | Status indicator       | Used to indicate the current equipment operating status: Color light: System in preparation; Green: Ready; Yellow: Meet the security interlock loop, laser ready/emit state; Red: Fault alarm; White: Main power supply not ready; Blue: System communication error |
| 6   | LOGO                   | Product brand label   |
| 7   | Air filter mesh        | Used to filter large particles of dust in the operating environment and required to be cleaned regularly  |

### 3.4 Schematic Diagram of Product Appearance Interface



| S/N | Name                            | Description   |
|-----|---------------------------------|---|
| 1   | User interface (DB25)           | Used to connect the input and output of external safety locks and linkage control signals.  |
| 2   | Equipment power input port      |  AC input socket: AC 220V, 50/60Hz, 23A  |
| 3   | Safety lock interface           | The workpiece safety clamp cable is connected to the interface. When the handheld welding head nozzle is connected to the workpiece to be welded, the security interlock loop between the handheld welding head nozzle and the safety clamp will be enabled, and only at this moment, the laser emission will be allowed. |
| 4   | Handheld welding head interface | The welding head signal is connected to this interface through a cable, and the exterior is protected by a self-winding woven mesh.   |
| 5   | Gas inlet                       | The protective and cooling gas inlet is connected by an 8mm air pipe.   |
| 6   | Wire Feeder Interface           | Data connection to the wire feeder  |

### 3.5 Schematic Diagram of Handheld Welding Head

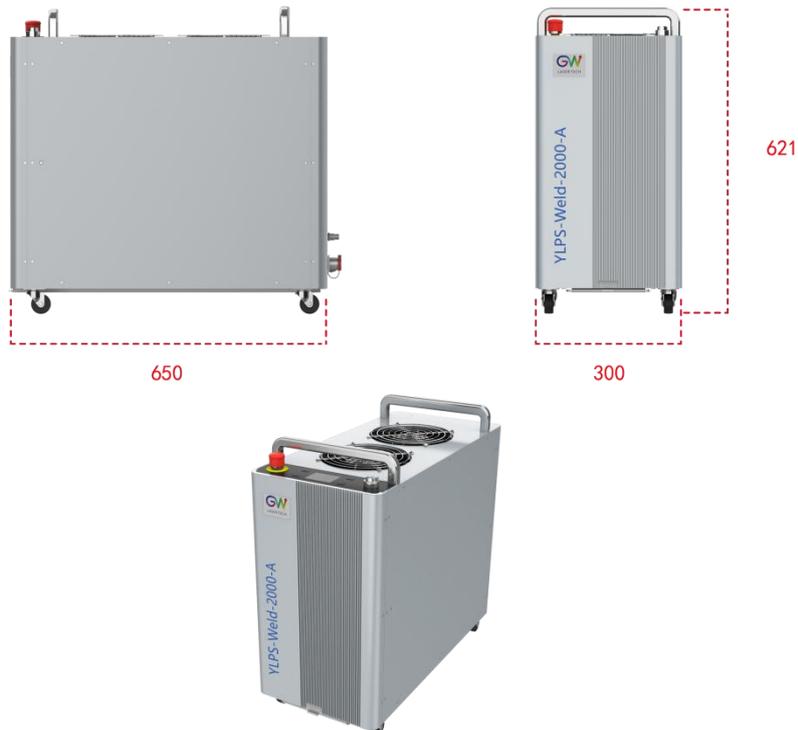
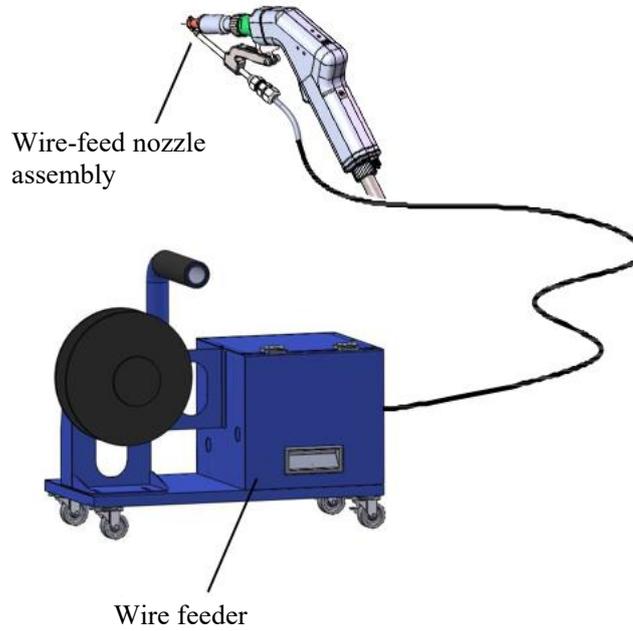


| S/N | Function item                         | Description  |
|-----|---------------------------------------|--|
| 1   | Trigger button                        | Start the protective/cooling gas flow and start the laser emission, press and hold the trigger to start the protective gas flow, and start the laser output according to the light output delay set by the system; It must be kept tight throughout the welding process.<br><b>When the workpiece safety clamp and the nozzle of the welding head do not form a conduction loop, press the trigger to allow only the gas to flow</b> |
| 2   | Protective lens                       | Protect the cable to prevent welding slag from entering the welding torch  |
| 3   | Nozzle                                | One equipped with four spare nozzle heads as a standard;   |
| 4   | Telescoping tube                      | The tip of the nozzle is threaded into the pipe.   |
| 5   | Protective and cooling gas connection | Connect the protective and cooling gases   |
| 6   | QBH optical cable connection          | The optical cable has been inserted and connected to the welding head.   |



### 3.5.1 Automatic Wire feeding System for Welding Head (Optional)

The wire-feed nozzle bracket part can be adjusted according to the use scenario, as shown in the following figure. The wire feeding angle for the straight pipe is 40°

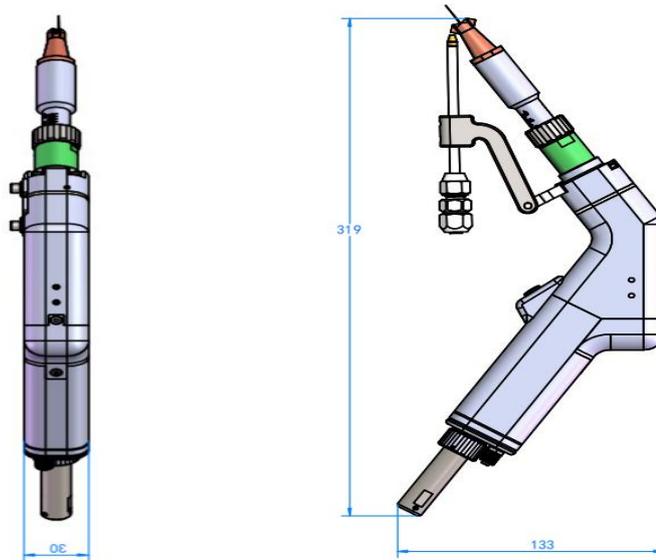


### 3.6 Product Layout and Dimensions

|                   |                                     |
|-------------------|-------------------------------------|
| <b>Dimensions</b> | <b>650 x 300 x 621 [mm] (L×W×H)</b> |
|-------------------|-------------------------------------|

|               |                         |
|---------------|-------------------------|
| <b>Weight</b> | <b>Less than 60[kg]</b> |
|---------------|-------------------------|

Z Z

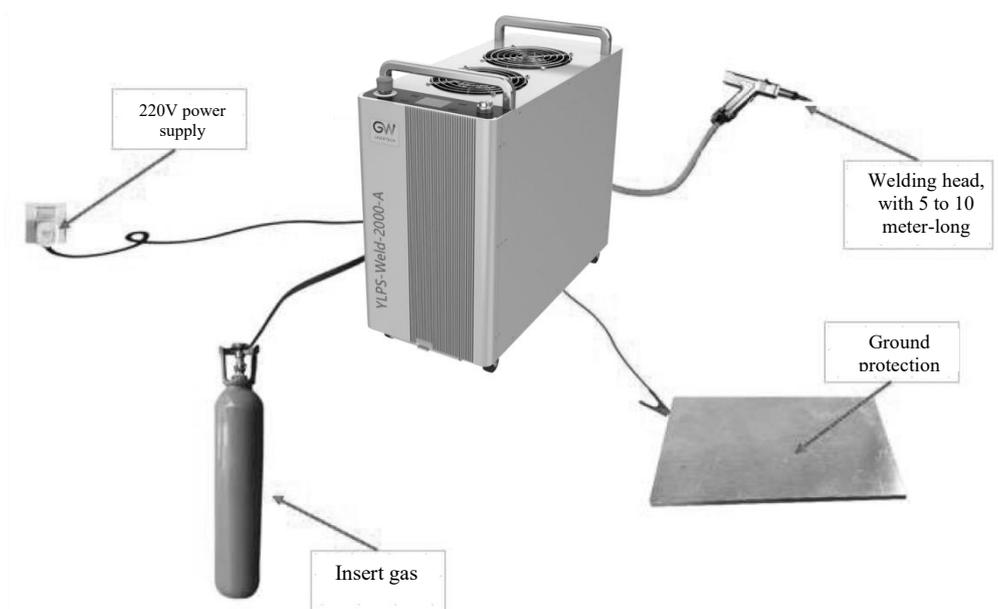


**Dimension unit: mm**

## 4. Welding Equipment Installation

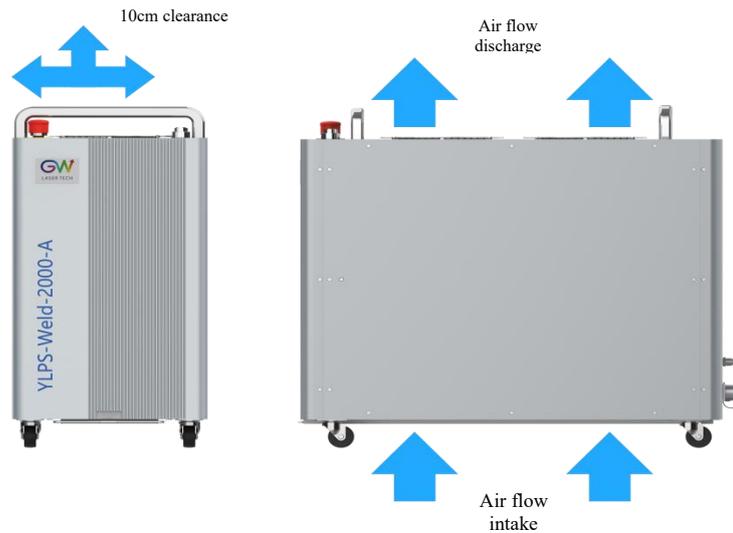
### 4.1 Preparation Before Installation

Please refer to the power requirements in Section 3.1 and ensure that the standards specified in the input voltage specification are met before switching on the power supply. The equipment must be connected with auxiliary gas of sufficient air volume before it can run, so as to dissipate the heat load generated during operation and protect from the damage to the welding head caused by the splash generated during the working process. If the gas is not connected, the equipment will automatically alarm and disable operation.



#### 4.2 Air Flow and Installation Gap

Hand-held laser welding system adopts the air cooling heat dissipation mode. When selecting the installation position, please do not run in an airtight, narrow and small space and be sure to run in a space with good air circulation conditions. Do not place any object that may block the exhaust on the top of the machine, with the gas flow direction as shown in the figure below:



### 4.3 Safety Protection Device Connection

A safety protection device (red wiring terminal) is provided on the rear panel of the equipment. As shown in the figure below; Before turning on the laser, the workpiece safety clamp cable must be connected to the ground protection device and the workpiece. When the handheld welding head nozzle is placed on the workpiece, the security protection loop will be switched on, and the laser emission will enter the ready state. At this time, the equipment panel indicator is in orange. Only when the security protection loop is effective, the laser can be emitted when the handheld welding head nozzle is always electrically connected (in contact) with the workpiece. When the security protection loop is not switched on, pressing the trigger of the handheld welding head only allows the auxiliary gas to flow.

As shown in the figure below, the operator must connect the workpiece safety clamp cable to the safety protection interface installed on the rear panel of the equipment. When the handheld welding head nozzle touches the workpiece, the safety protection of the closed loop is effective. If the operator lifts the nozzle from the workpiece during operation, the safety loop will be disconnected and the laser will automatically turn off.



### 4.4 Welding Auxiliary Gas Connection

The welding gas input port can only be connected with an 8mm gas pipe. As shown in the following figure, insert the gas pipe into the quick connector of the gas inlet. Once connected, open the external gas valve to supply the gas. It is recommended to use inert gas in welding work to protect the quality of the weld seam during welding. Input gas pressure should be greater than 0.3bar and less than 6.0bar. The output gas pipe must be connected to the handheld welding head to work, and the outside of the output gas pipe is protected by a self-winding woven mesh.



| Item                   | Specification                                       |
|------------------------|---|
| Standard auxiliary gas | Argon, nitrogen, argon + carbon dioxide gas mixture |
| Input gas pressure     | Min. 0.3bar, max. 6.0bar                            |

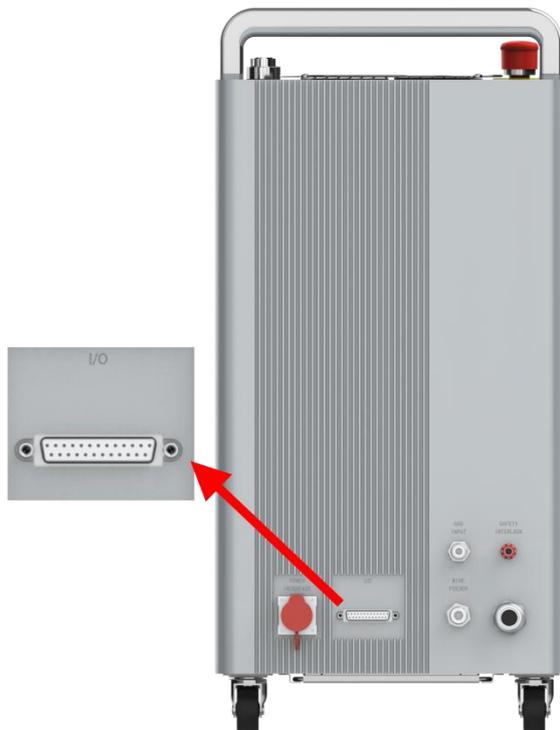
#### 4.5 Handheld Welding Head Cable Connection

Connect the 12-core control wire cable of the welding head to the rear panel, as shown in the following figure. The wire cable has been connected to the handheld welding connector before delivery. Do not disconnect the connection unless necessary.



#### 4.6 User Interface

The user interface includes the DB25 computer interface for connecting external control signals, the RS232 communication interface, and the WI-FI transmission interface. Users can use the DB25 computer interface to implement security interlock control with external equipment, obtain equipment status and alarm information, and control the execution of external equipment. The RS232 interface allows users to connect to the control software of the host computer to achieve richer monitoring operations, and the Wi-Fi transmission interface is used to connect to wireless hotspots, and connect to SMAT Cloud cloud services to obtain remote firmware upgrades and remote services.

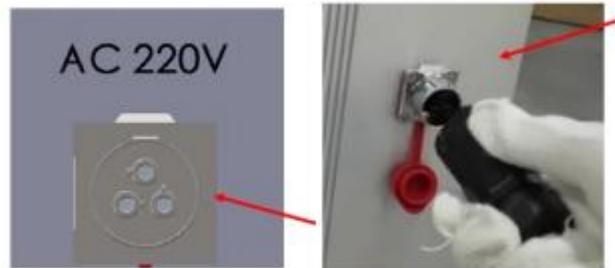


| <b>User interface (DB 25Pin)</b> |                   |                        |                    |  |
|----------------------------------|-------------------|------------------------|--------------------|--|
| <b>Pin#</b>                      | <b>Definition</b> | <b>Description</b>     | <b>IN/<br/>OUT</b> | <b>Notes</b>                             |
| 1                                | GNDB              | Communication ground   |                    | 0V                                       |
| 14                               | TXD               | Data output            |                    | -10V—10V                                 |
| 2                                | RXD               | Data input             |                    | -10V—10V                                 |
| 15                               | BOOTW             | BOOTW                  |                    |  |
| 3                                | G1                | Wire-feed signal       |                    | Dry node signal                          |
| 16                               | G2                | Wire-back signal       |                    | Dry node signal                          |
| 4                                | S-LAS             | Laser activation state | OUT                | Output laser start signal (24V)          |
| 17                               | 24V               | Ext 24V                | OUT                | Supply 24VDC output                      |
| 5                                | S-ERR             | System error           | OUT                | System error output (24V)                |
| 18                               | S-WAR             | Wire-feed signal+      | OUT                |  |
| 6                                | S-RDY             | Wire-back signal+      | OUT                |  |
| 19                               | NC                |                        |                    |  |
| 7                                | NC                |                        |                    |  |
| 20                               | NC                |                        |                    |  |
| 8                                | X-STOP            | Security interlock+    | IN                 |  |
| 21                               | SN3               | Enable                 |                    | Low-level enabled, combined with 12 pins |
| 9                                | X-KEY             | Emit switch+           | IN                 |  |
| 22                               | X-WAT             | Air valve switch input | IN                 | Receive air valve start signal (24V)     |
| 10                               | NC                |                        |                    |  |
| 23                               | NC                |                        |                    |  |
| 11                               | FAN               | Air valve open         | OUT                | Open air valve                           |
| 24                               | NC                |                        |                    | N/A                                      |
| 12                               | 0V                | 0V                     | IN                 | Digital signal reference potential       |
| 25                               | NC                |                        |                    |  |
| 13                               | NC                |                        |                    |  |

| RS232 communication interface (DB 9Pin) |            |             |        |          |
|---|------------|-------------|--------|----------|
| Pin#                                    | Definition | Description | IN/OUT | Notes    |
| 2                                       | TXD        | Data output |        | -10V~10V |
| 4,7-9                                   | NC         |             |        | N/A      |
| 3                                       | RXD        | Data input  |        | -10V~10V |
| 5                                       | GND        | Grounding   |        | 0V       |

#### 4.7 Power Supply Connection

Before connecting the power supply, ensure that the power supply capacity meets the specifications described in Section 3.1. The equipment comes with an RVV 3x4mm<sup>2</sup> connection wire cable. Please follow the steps below to connect the wire cable correctly according to the wire cable harness label:



| Main power port 3-Pin |                    |                   |               |
|-----------------------|--------------------|-------------------|---------------|
| Pin#                  | Function           | Wire color        | Power voltage |
| 1                     | Phase-line voltage | Red (L1)          | 220VAC        |
| 2                     | Null line voltage  | Black (L2/N)      | 0VAC          |
| 3                     | Grounding          | Green/yellow (PE) | PE            |

1. Connect the power input cable to the indicated voltage and phase, at frequency 50/60Hz. L1= phase line voltage, L2= null line voltage, PE= ground,
2. The equipment power input cable must be connected to the dedicated AC mains electricity through a circuit breaker not exceeding 30 amps. Mark the area easily accessible by the operator to identify the disconnect device that supplies power to the equipment;
3. Wiring should meet all national and local regulatory requirements, and electrical connections should be carried out by professional electrical safety personnel.

#### 4.8 System Startup and Shutdown

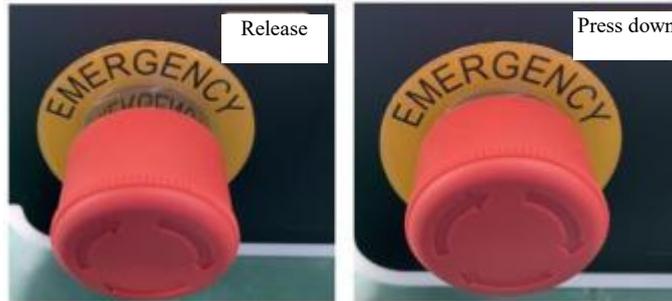
Before supplying power to the equipment, all electrical connections must be connected. Where applicable, all connections must be secured with screws or fasteners to ensure proper functioning. Ensure that you wear appropriate personal protective equipment when handling this product. These include welding helmets, flame-retardant protective gloves and laser safety eyewear suitable for use at 1070nm wavelengths.

**WARNING**



**When maintaining the output cable, disconnect the main power supply of the equipment and remove the input cable connector. The minimum allowable bending radius of the optical cable is 50mm.**

1. Ensure that all connections necessary for normal operation have been completed, including the limitations of external safety protection devices. At the same time, check whether the security protection loop is connected properly and the external security interlock loop is in the closed state.
2. Make sure that the scram button is not pressed. If pressed down, turn clockwise to reset the scram button.



3. Turn the key switch clockwise to the (ON) position;



5. After the rear panel is started, the indicator and display screen will be lit. In the process of startup, the indicator light is in a color circulating state. After the completion of system starting, the indicator light will turn green in normally-on state. At this time, the equipment can enter the working state.

*\* In case of any other status displayed, please refer to the description information in Section 3.3 or the error information in Section 7.1. If it cannot be excluded, please contact service personnel.*

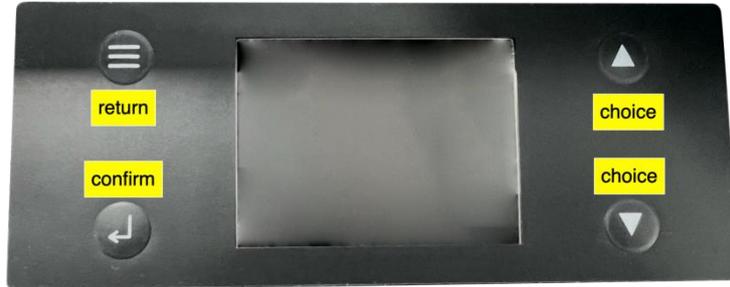
**System shutdown:**

To turn off the laser welding system, the user must stop emitting the laser after the welding is completed; 1. Release the trigger of the handheld welding head, and the system will stop emitting the laser and terminate the gas flow at the same time (if any gas extension shutdown parameter is set, the system will stop after the set time). Turn the key switch counterclockwise to the (OFF) position and remove the key from the product and secure the key to prevent from unauthorized use.

## 5. Laser Welding System Operation

### 5.1 Control Panel Operation

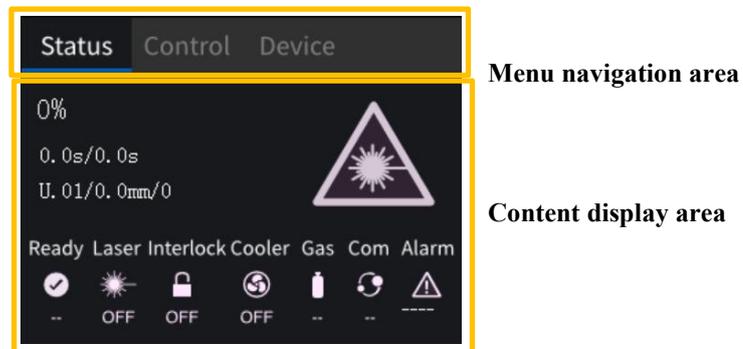
The equipment operation panel consists of four inching buttons and an LCD screen for viewing equipment status and equipment information, and adjusting system operating parameters.



a. Introduction to button functions:

| Button illustration   | Fuction description   |
|---|---|
|  <b>Menu key</b>     | It is the upper-level menu used to return to the currently displayed page when the user interface is not a status page. Continuous clicking will help eventually return to the status page. |
|  <b>Confirm key</b> | It is used to confirm the selection of user interface menu and parameters, enter the advanced parameter setting interface, and save parameters after modification.                          |
| <b>Up key</b>   | Select a menu in the user interface and add the parameters. Long pressing on the parameter selection and parameter adjustment page to add parameters in increments of x10.                  |
|  <b>Down key</b>   | Select a menu in the user interface and reduce the parameters. Long pressing on the parameter selection and parameter adjustment page to reduce the operations in increments of x10.        |

b. Introduction to user interface:



As shown in the figure above, the user operation interface is mainly divided into the menu navigation area and the content display area. The displayed content will change according to the user's operation. After the equipment is started, it will be displayed on the status page by default, which is used to display the current



operating information of the equipment. The up and down buttons on the panel allow you to switch between different menu pages.

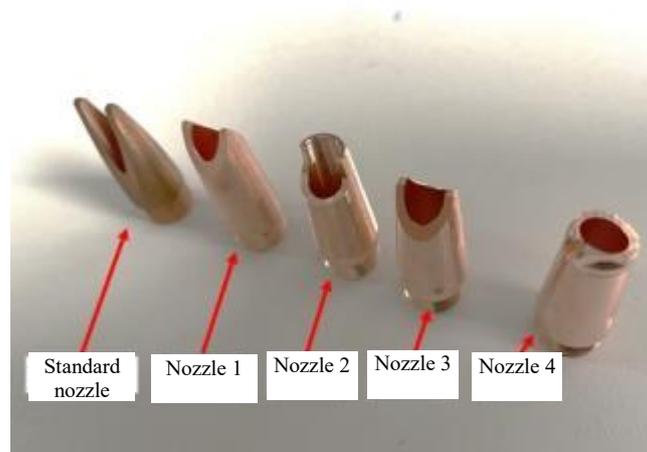
## 5.2 Welding Head Usage and Operation

### 5.2.1 Nozzle Installation

Before replacing the nozzle tip, close the equipment nozzle tip to connect the thread to the extension tube of the welding head.



There are five types of nozzles, as shown in the figure below:



### 5.2.2 Nozzle tube adjustment

Before adjusting the nozzle tube, please use the key switch button to turn off the equipment. When adjusting the nozzle tube, loosen the nut first, as shown in the figure.

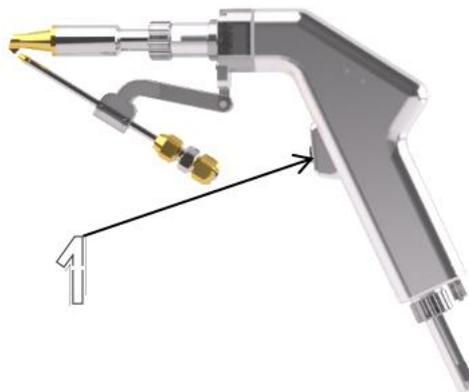


Once positioned correctly, tighten the nut and lock the nozzle tube in place, as shown in the figure. Tighten with your hand!



### 5.2.3 Handheld Welding Head Operation

#### **Laser emitting warning!**



Press down Trigger 1 on the welding head to turn on the protective gas. The protective gas will be held for 2 seconds (the gas delay time can be configured through the "Gas outlet delay" parameter) and then the laser will start. The laser emission is started on the premise that all security interlock control conditions are satisfied and the preset gas outlet delay is ended. In the welding process, the operator must continue to hold the switch being pressed to keep the laser emitted. Releasing Trigger 1 or failure of the security interlock loop will terminate the laser emission.

## 5.3 Important Safety Functions

### 5.3.1 Optical Cable Connection and Interlocking

Optical fiber connection and interlocking serves as a security protection loop between the handheld welding head and the optical cable interface of the equipment, which is used to limit the laser emission of the equipment when the external optical device is not connected. It is a method to ensure the interlock protection between the optical cable output interface and the handheld welding head. If the output cable of the equipment is not correctly connected to the welding head, the laser is prohibited from emitting, and meanwhile, the system displays the interlock status of the output signal on the user interface to inform the user whether the current loop is normal.

### 5.3.2 External security interlock loop

The laser welding system includes an external security interlock loop, and the user's operator connects the safety grating, safety door and other safety protection devices. External interlocks need to be connected through an external user interface, and the security loop must be kept closed at all times (see Section 4.6 Interface Definition. If the dry contact signal is used, on the DB25 pin connector: Pin 8 is connected with Pin 17), otherwise the laser emission will be prohibited, the welding system will output an alarm message, the panel status indicator will turn red, and the user interface will also inform the user through an alarm code.

### 5.3.3 Security protection loop between workpiece safety clamp and handheld welding head

The security loop ensures that the laser is only allowed to be emitted when the nozzle is connected (in contact) with the workpiece. The operator must fasten the workpiece safety fixing part to the metal workpiece to be machined. When the nozzle of the welding head touches the workpiece, the loop between the welding head nozzle and the workpiece safety clamp will be turned on and activated. If the operator removes the nozzle from the machined workpiece, this security interlock loop will be cut off, the laser will automatically turn off, and laser emission will be prohibited.

### 5.3.4 Button Function Limitations of the Handheld Welding Head

As to the trigger button on handheld laser welding head when the said security interlock loop is turned on, if the user presses down the trigger button, at this moment, only the auxiliary gas valve is allowed to open, allowing the gas flowing through the welding head nozzle, while it is not allowed to emit the laser and execute the preset operation program. If the above security interlock conditions are satisfied, the trigger button will be used as the trigger device for program operation. When the user presses down the trigger button, the preset gas outlet delay program will be executed first, and the gas outlet delay time will be executed according to the parameters set by the user. The laser will be emitted after the completion of the gas outlet delay execution. In order to complete the welding work, the operator must continuously hold the trigger button pressed so that the laser emission remains.

### 5.3.5 User Operation Status and System Running Status

Assuming that the above security protection interlocks are all closed, the user operation and system running status are shown as in the table below:

| S/N | User operation<br>(The security interlock loop is turned off) |                             | Laser    | Indicating light | Beam swing | Auxiliary gas |
|-----|---|-----------------------------|----------|------------------|------------|---------------|
| 1   | Workpiece safety clamp<br>Trigger button                      | Disconnection<br>Loosened   | Turn off | Turn on          | Turn off   | Turn off      |
| 2   | Workpiece safety<br>clamp<br>Trigger button                   | Disconnection<br>Press down | Turn off | Turn on          | Turn off   | Turn on       |
| 3   | Workpiece safety<br>clamp<br>Trigger button                   | Switch on<br>Loosened       | Turn off | Turn on          | Open 1     | Turn off      |
| 4   | Workpiece safety<br>clamp<br>Trigger button                   | Switch on<br>Press down     | Open 2   | Turn on          | Open 1     | Turn on       |

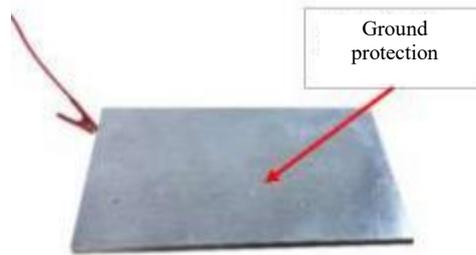
**Note 1: Only if the user sets the swing width, the beam will swing according to the set value, otherwise it will remain fixed.**

Note 2: If the program sets the gas close delay upon gas outlet delay, the laser will not be emitted immediately when the trigger is pressed, and the laser will be emitted only after the end of the set gas outlet delay, which is the normal operating state.

#### 5.4 Begin Welding

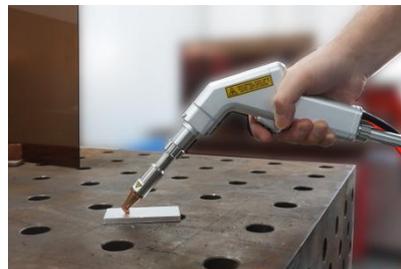
All personnel in the welding area must wear personal protective equipment to protect against invisible infrared lasers and any secondary visible and invisible radiation generated during welding. Appropriate laser safety eyewear and a welding helmet with suitable filter lens are required. Safety equipment for welding operators also includes welding helmets and fire-resistant protective clothing and gloves.

1. Check whether the security loop is working properly. If the security loop is not working properly, the indicator on the panel will turn red for alarming and the corresponding alarm code will be displayed. When the security loop is normal, the alarm is cleared. If the equipment indicator is in green, it indicates that the security loop is in the ready state;
2. Select the appropriate welding nozzle and install the nozzle onto the welding head extension pipe;
3. On the user operation interface, select the preset parameters (see section) S.01. Process a 1mm thick aluminum plate in continuous laser mode.
4. Place the workpiece to be welded on the welding workbench and clamp it. In laser welding work, it is necessary to ensure that there is a minimum gap between the parts and as close as possible.
5. Ensure that the "workpiece safety clamp" is connected to the part or the conductive welding bench on which the part is placed. As shown in the figure below.



6. Make the tip of the nozzle in touch with the part being welded. This closes the security interlock loop between the workpiece safety clamp and the handheld welding head, with the equipment in a ready state and the equipment indicator light in orange.
7. Press the trigger button on the handheld welding head to trigger and turn on the protective gas and wait for the laser to start.
8. When the laser is emitted, the welding head can be moved slowly to complete the welding operation. During the welding process, the trigger button of the welding head should be held pressed, otherwise the welding procedure will be interrupted, and the laser emission will be terminated. The equipment indicator will be always in orange during the working process.
9. Since the infrared laser beam is invisible, it is required to use the red guide beam to position the nozzle correctly on the part.

The picture below shows the proper angle for holding the welding head when the nozzle is positioned to the part being welded.

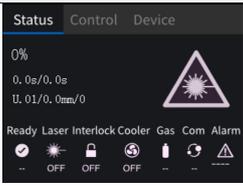
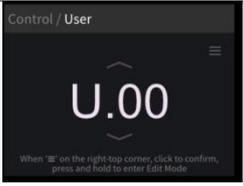
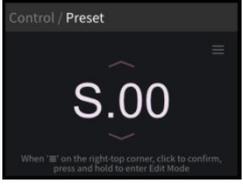
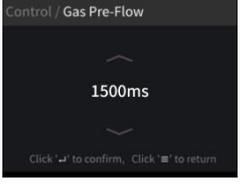


To further improve the process, the operator can use buttons on the LCD panel to adjust some process settings by increasing or decreasing the laser power, swing frequency, swing width and other parameters.

## 6. User Interface Function Introduction and Process Parameter Setting

### 6.1 Introduction to the Menu Structure of User Interface

The user interface is mainly composed of status page, control page and equipment page. The following table briefly describes the hierarchical structure and function description:

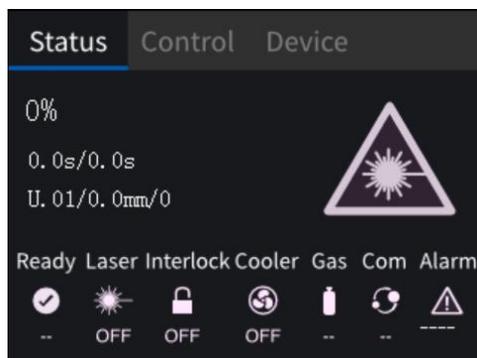
| Level I page | Level II page    | Interface preview   | Fuction description   |
|--------------|------------------|---|---|
| Status       |                  |    | This interface is used to display information such as the operating parameters and operating status of the current equipment in a centralized manner. After the equipment is started, this interface will be displayed by default.  |
| Control      |                  |    | The user can enter the process parameters through the control page. The page includes the menu entry of user parameters, preset parameters, gas outlet delay, and gas close delay. When the "=" sign is displayed in the upper right corner, single click the confirm button to activate the current selection, long press the confirm button to enter the parameter editing page, and single click other parameters to conduct modification.                                       |
|              | User parameter   |  | On the user parameter selection page, the user can select the parameter number by pressing the up and down buttons on the operation panel. Single click the confirm button to save the current serial number. If it is required to adjust other settings in the selected parameter, press and hold the confirm button to enter the detailed setting screen. For details, refer to the function introduction of section 6.3.1.   |
|              | Preset parameter |  | On the user parameter selection page, the user can select the parameter number by pressing the up and down buttons on the operation panel. Single click the confirm button to save the current serial number. Press and hold the confirm button to enter the detailed setting screen. The preset parameters are the default parameters of the system, and only part of setting options are available for the user. For details, refer to the function introduction of section 6.3.2 |
|              | Gas outlet delay |  | In this interface, you can set the gas outlet delay before the laser emission and set to release the auxiliary gas in advance. After pressing down the trigger button of the welding head, the system will release the gas according to   |

|           |                 |  |  |
|-----------|-----------------|--|--|
|           |                 |  | the set time and then start the laser.   |
|           | Gas close delay |  | In this interface, you can set the gas close delay after the ending of laser emission and set to continue releasing the auxiliary gas. When the trigger button of the welding head is released, the system will release gas according to the set time and then end the program. During the execution, the laser is in the off state. |
| Equipment |                 |  | The equipment page provides an entry for users to view equipment information   |
|           | Service code    |  | This interface displays the unique service code of the equipment, which is used for the feature recognition of the equipment service   |
|           | Information     |  | This page displays equipment operating information, including software version information, environment information, and hardware information of the equipment.  |

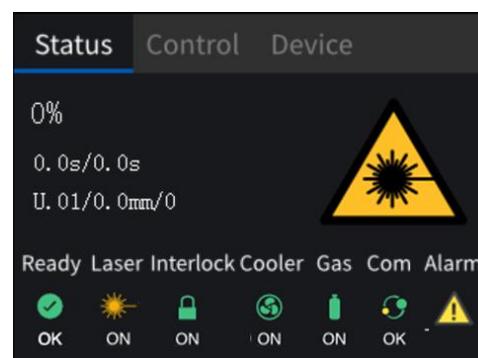
The function usage and introduction of each interface will be detailed in the following sections.

## 6.2 Usage of User Interface Status Page

The user page is displayed by default after the equipment is started. When you are in other pages, you can click the menu key to return to the status page layer by layer.



**a** Indicates the non-activated status



**b** Indicates the activated status

| Display content   | Description   |                     |                     |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |
|---|---|---------------------|---------------------|---------------------|---------------------|-----------------|---|-----------------|---------------|-----------------|---|-----------------|---------------|------------|---|-------------|---------------|-------------------|---|---------------|----------------|-------------|---|------------------|---------------|
| <p>(Inactivation and activation status)</p> <div style="background-color: black; color: white; padding: 5px; margin: 10px 0;"> <p style="font-size: 24px; margin: 0;">100%</p> <p style="font-size: 12px; margin: 0;">U.01 / 0.5 s / 1.0 s</p> <p style="font-size: 12px; margin: 0;">C / 100Hz / 5.0 mm</p> </div> | <p>This area displays the setting content of the current equipment operating parameters. The first line displays the power ratio used by the current equipment in percentage, and the second line is separated by a punctuation symbol of "/", respectively displaying the program number/gas outlet delay/gas close delay selected by the user. The content of the third line is separated by a punctuation symbol of "/", and the display content and definition will vary in different operating modes (See the table below) :</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 25%;">Operating mode</th> <th style="width: 15%;">Mode code</th> <th style="width: 25%;">Display parameter 1</th> <th style="width: 35%;">Display parameter 2</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Continuous mode</td> <td style="text-align: center;">C</td> <td style="text-align: center;">Swing frequency</td> <td style="text-align: center;">Swing breadth</td> </tr> <tr> <td style="text-align: center;">Modulation mode</td> <td style="text-align: center;">M</td> <td style="text-align: center;">Swing frequency</td> <td style="text-align: center;">Swing breadth</td> </tr> <tr> <td style="text-align: center;">Pulse mode</td> <td style="text-align: center;">P</td> <td style="text-align: center;">Pulse width</td> <td style="text-align: center;">Swing breadth</td> </tr> <tr> <td style="text-align: center;">Linear array mode</td> <td style="text-align: center;">S</td> <td style="text-align: center;">Laser on time</td> <td style="text-align: center;">Laser off time</td> </tr> <tr> <td style="text-align: center;">Timing mode</td> <td style="text-align: center;">T</td> <td style="text-align: center;">Time of duration</td> <td style="text-align: center;">Swing breadth</td> </tr> </tbody> </table> | Operating mode      | Mode code           | Display parameter 1 | Display parameter 2 | Continuous mode | C | Swing frequency | Swing breadth | Modulation mode | M | Swing frequency | Swing breadth | Pulse mode | P | Pulse width | Swing breadth | Linear array mode | S | Laser on time | Laser off time | Timing mode | T | Time of duration | Swing breadth |
| Operating mode  | Mode code   | Display parameter 1 | Display parameter 2 |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |
| Continuous mode   | C   | Swing frequency     | Swing breadth       |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |
| Modulation mode   | M   | Swing frequency     | Swing breadth       |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |
| Pulse mode  | P   | Pulse width         | Swing breadth       |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |
| Linear array mode   | S   | Laser on time       | Laser off time      |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |
| Timing mode   | T   | Time of duration    | Swing breadth       |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |
| <div style="display: flex; gap: 10px;">   </div>  | <p>When the laser is in the state ready for emitting or in the emitting state, the icon will be displayed in a yellow background, otherwise it means that the laser is neither in the state ready for emitting nor in the emitting state.</p>   |                     |                     |                     |                     |                 |   |                 |               |                 |   |                 |               |            |   |             |               |                   |   |               |                |             |   |                  |               |

|   |   |  |
|---|---|--|
|    |    | After the system is started, the cooling system is normal, gas input is normal, the communication is normal, the security interlock loop is closed, and then the ready icon is activated when no other alarm is generated  |
|    |    | The icon will be activated when the laser is in the state ready for emitting or in the emitting state. At this time, the operator and the surrounding user should do a good job of safety protection. For details, please refer to Section 5.4   |
|    |    | The icon is activated when all security protection loops are closed  |
|    |    | After the system is powered on, it takes a certain amount of time before the cooling system is ready to start. Generally, the startup time is less than 30 seconds. When the cooling system is ready to start, this icon will be activated   |
|    |    | After the external auxiliary gas is connected to the equipment, if the access pressure meets the system requirements (see Section 4.4), the icon will be activated, and the input gas pressure shall be greater than 0.3bar and less than 6.0bar   |
|   |   | This icon is only used for indicating the communication status of internal control signals of the system. When the internal signal communication of the system is normal, the icon is activated  |
|  |  | In case of any fault or an alarm occurring during the system operation, this icon will be activated. All fault codes will be displayed below the icon in a scrolling way. Users can record the fault codes and consult the contents described in section 7.1 for information comparison. |

### 6.3 Usage of User Interface Control Page

The control page contains four options: User parameters, preset parameters, gas outlet delay, and gas close delay. After entering this page, single click the "Confirm" button on the operation panel to enter the parameter selection state. You can select parameters by clicking the up button or the down button on the operation panel. When a parameter is selected, the background color will turn blue. After selection, single click or long press1 "Confirm button" to enter the parameter setting page.

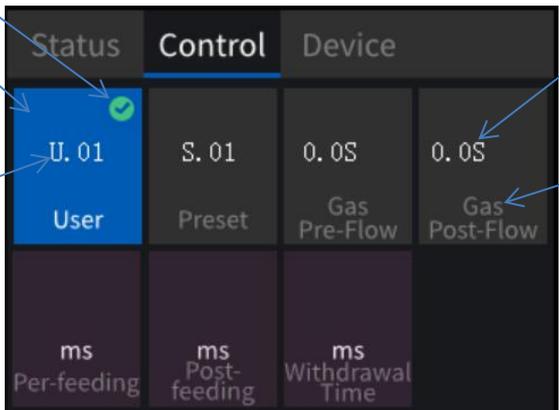
Parameter activation status

Chosen status (blue)

Parameter name

Current parameter value

Unchosen status (grey)



| Status            | Control            | Device                |                        |
|-------------------|--------------------|-----------------------|------------------------|
| U. 01<br>User     | S. 01<br>Preset    | 0. 0S<br>Gas Pre-Flow | 0. 0S<br>Gas Post-Flow |
| ms<br>Per-feeding | ms<br>Post-feeding | ms<br>Withdrawal Time |                        |

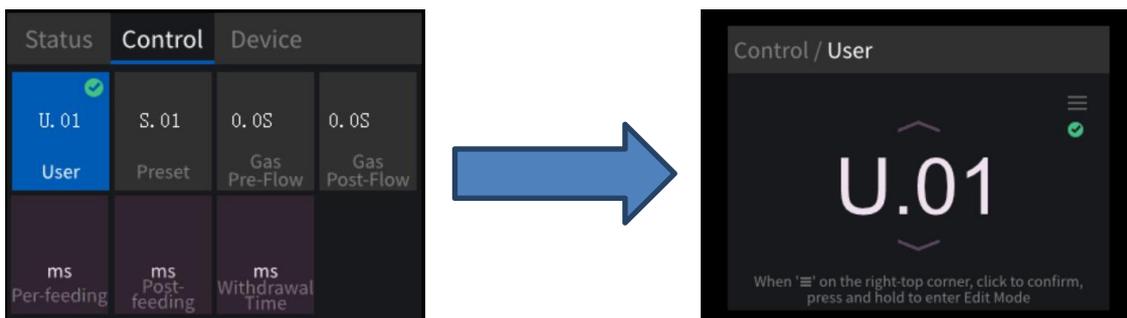
Note 1: When the "☰" mark is displayed in the upper right corner, single click the Confirm button on the operation panel to activate the current selection. Press and hold the Confirm button on the operation panel to enter the parameter editing page

### 6.3.1 User Parameter Setting

The system provides users with 20 groups of running programs, numbered from U.0 to U.19, which can be customized to set parameters. The operator can choose a set of programs to modify until the work needs are met, and the parameters set by the user will be saved in the system by default for reuse next time.

Specific steps to enter parameters:

Select user parameters on the control page, press and hold the confirm button on the operation panel, and wait 0.5 seconds to enter the program selection page.



In the user parameter program number selection page, the current program number can be increased or decreased through the up and down buttons in the operation panel. When the up button is continuously pressed, the program number will be increased up to U.19, and when the down button is continuously pressed, the program number will be reduced down to U.00. When the required program number is reached after adjusting, single click the confirm button on the operation panel to activate the selection of the current program number, while the green icon "☑" is displayed in the upper right corner, indicating the activation state.



To modify the selected program number, press and hold the Confirm button on the operation panel for more than 0.5 seconds to enter the detailed parameter equipment page.



In the user program mode, you need to confirm the operating mode selected by the current program before entering the parameter setting. The system provides users with 5 operating modes to choose from.

- Continuous mode - For continuous welding of most sheet metal (see section 6.3.1.1)
- Modulation mode - for the welding of sheet metal (see section 6.3.1.1)
- Linear array mode - for welding in linear segments (see section 6.3.1.1)
- Pulse mode - for welding of highly-reflective materials (see section 6.3.1.1)
- Timing mode - for inching-type welding (see section 6.3.1.1)

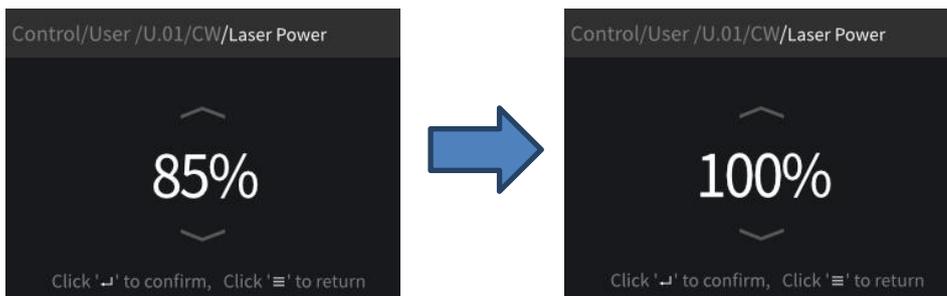
Here, we take the linear array mode as an example to describe the method of parameter setting in detail. Select the linear array mode according to the aforementioned operating method, single click the Confirm button to activate the linear array mode, and the green icon will be displayed in the upper right corner. Press and hold the “Confirm” button on the operation panel for 0.5 seconds to enter the parameter setting page of the “linear array mode”.



After entering the parameter selection page, single click the Confirm button to enter the parameter adjustment operation. The adjustment range of each parameter will vary. By taking the “Laser Power” change as an example for the interface adjustment, adjust the laser power from 85% to 100%. Single click the Confirm button to enter the parameter adjustment page.



Press the up button on the operation panel to adjust the setting value to 100%. After the adjustment is completed, single click the Confirm button to save the settings.



Click the menu key to return to the previous page, and you can see that the laser power setting value is displayed as the modified 100%, and the modified result has taken effect.



|   |                  |    |   |      |     |     |  |
|---|------------------|----|---|------|-----|-----|--|
| 1 | Laser power      | %  | 0 | 100  | 1   | 100 |  |
| 2 | Swing frequency  | Hz | 0 | 300  | 1   | 0   |  |
| 3 | Swing breadth    | mm | 0 | 5    | 0.1 | 0   |  |
| 4 | Slow rise time   | ms | 0 | 2000 | 1   | 500 |  |
| 5 | Slow drop time   | ms | 0 | 9999 | 1   | 500 |  |
| 6 | On/off time      | ms | 0 | 3500 | 1   | 500 |  |
| 7 | Laser off time   | ms | 0 | 3500 | 1   | 500 |  |
| 8 | Repetition times | #  | 1 | 9999 | 1   | 0   |  |

For the parameter definitions, please refer to the description in the glossary of Section **6.3.1.2**

**. Pulse mode - For welding of highly-reflective materials**

| S/N | Parameter name  | Unit | Min. value | Max. value | Adjustment amount | Default value | Description                        |
|-----|-----------------|------|------------|------------|-------------------|---------------|------------------------------------|
| 1   | Laser power     | %    | 0          | 100        | 1                 | 100           | Less than twice the standard power |
| 2   | Swing frequency | Hz   | 0          | 300        | 1                 | 0             |                                    |
| 3   | Swing breadth   | mm   | 0          | 5          | 0.1               | 0             |                                    |
| 4   | Pulse frequency | Hz   | 0          | 50000      | 1                 | 500           | Meet QCW operating limits          |
| 5   | Pulse width     | %    | 10         | 100        | 1                 | 50            | Meet QCW operating limits          |
| 6   | Pulse waveform  | #    | 0          | 19         | 1                 | 0             | 0 for infinity                     |

For the parameter definitions, please refer to the description in the glossary of Section **6.3.1.2**

**. Timing mode - For inching-type welding**

| S/N | Parameter name  | Unit | Min. value | Max. value | Adjustment amount | Default value | Description |
|-----|-----------------|------|------------|------------|-------------------|---------------|-------------|
| 1   | Laser power     | %    | 0          | 100        | 1                 | 100           |             |
| 2   | Swing frequency | Hz   | 0          | 300        | 1                 | 0             |             |
| 3   | Swing breadth   | mm   | 0          | 5          | 0.1               | 0             |             |
| 4   | Slow rise time  | ms   | 0          | 2000       | 1                 | 500           |             |
| 5   | Slow drop time  | ms   | 0          | 9999       | 1                 | 500           |             |

For the parameter definitions, please refer to the description in the glossary of Section **6.3.1.2**

**6.3.1.2 Parameter Glossary of Operating mode**

| S/N | Parameter name   | Unit | Parameter definition  |
|-----|------------------|------|---|
| 1   | Preset parameter |      | Be the default process parameters of the system. Some parameters in the program allow users to modify. Besides, it is available to update to the latest process parameter set through remote service. |

|    |                  |    |  |
|----|------------------|----|--|
| 2  | Program No.      |    | Refer to the process parameters selected by the current user. The user parameters include 20 groups of customizable programs, and the preset mode includes 55 groups of process parameters   |
| 3  | Operating mode   |    | Refer to the operating mode of the current equipment, which specifies the parameter set that the user will use in the program  |
| 4  | Laser power      | %  | Set the maximum output power of the system, which is used to set the amplitude of the maximum output power of the equipment in non-continuous mode.  |
| 5  | Swing frequency  | Hz | Set the scanning frequency of the beam deflecting mirror in the handheld welding head. The equipment frequency is output in the form of triangular wave. The higher the frequency is set, the faster the scanning speed, and the smaller the vice versa.   |
| 6  | Swing breadth    | mm | Set the Angle value of the deflection mirror in the hand-held welding head to limit the width of the beam movement. The maximum limit of the swing width is set to 5mm. When it is set to 0, the deflection mirror will no longer move.  |
| 7  | Slow rise time   | ms | Be effective in the operating modes of "continuous mode", "linear array mode" and "timing mode". It is used to set the slow rise interval from 0% to the set power value after the laser emission is activated, and the result is that the laser output intensity changes from weak to strong.                         |
| 8  | Slow drop time   | ms | Be effective in the operating modes of "continuous mode", "linear array mode" and "timing mode", it is used to set the slow decline interval from the set power value to the complete shutdown after the laser emission is turned off, and the result is that the laser output intensity changes from weak to strong.. |
| 9  | Pulse frequency  | Hz | In the modulation mode and pulse mode, set the pulse running period of laser output  |
| 10 | Pulse width      | %  | In the modulation mode and pulse mode, set the effective output interval for each pulse running cycle, and when the pulse width is set to 100%, it is equivalent to that in the continuous mode. In pulse mode, the maximum value of pulse width will limit the set value of power.                                    |
| 11 | Laser on time    | ms | In linear array mode, determine how long the laser stays emitted after it is turned on.  |
| 12 | Laser off time   | ms | In linear array mode and timing mode, determine how long the laser stays emitted after it is turned on.  |
| 13 | Time of duration |    | In timing mode, determine how long the laser stays emitted after it is turned on.  |
| 14 | Repetition times |    | In linear array mode, set the number of repeated running cycle of the whole program, and stop the program execution when it runs to the set number   |

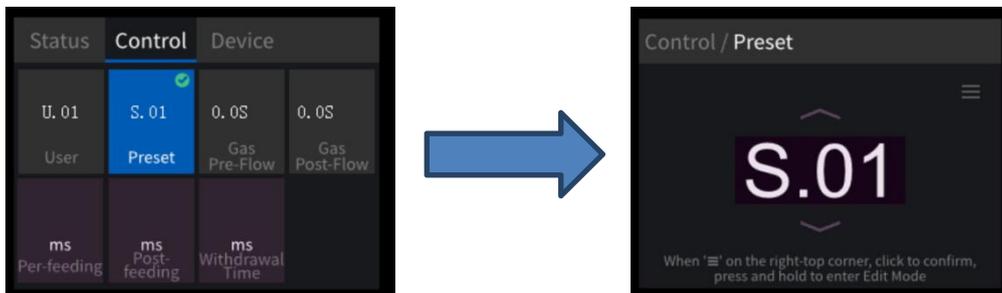
|    |          |  |
|----|----------|--|
| 15 | Waveform | In the modulation mode and pulse mode, the user can select different pulse waveforms to adjust the pulse transmission mode. The default waveform 0 is not changed, and the maximum value of output power will be adjusted with the preset waveform curve in case other waveforms are selected. |
|----|----------|--|

### 6.3.2 Preset Parameter Setting

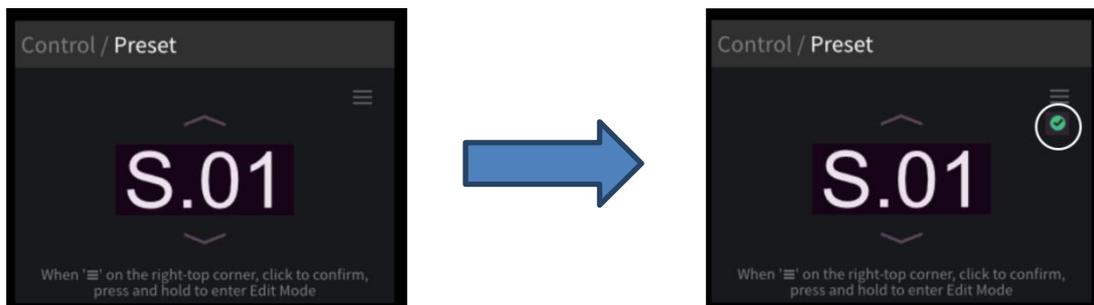
There are 55 groups of preset parameters in the system, numbered from S.00 to S.54. The program in the preset parameters is the default program of the system, and the user can choose a group of programs to modify it at will. However, compared with the user parameters, the operator can only modify specific parameters in the operating mode set by the system program and fine-tune the parameters. The parameters set by the user will also be saved in the system by default for reuse next time.

Specific steps to enter parameters:

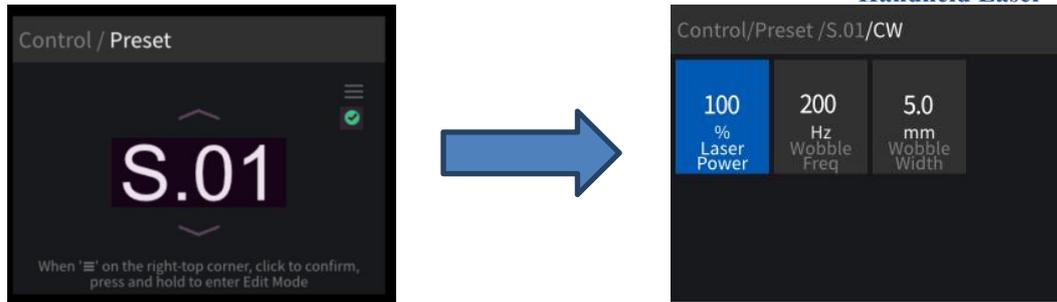
Select preset parameters on the control page, press and hold the Confirm button on the operation panel, and wait 0.5 seconds to enter the program selection page.



On the preset parameter program number selection page, the current program number can be increased or decreased through the up and down buttons on the operation panel. When the up button is pressed and held, the program number will be increased up to S.54, and when the down button is pressed and held, the program number will be reduced down to S.00. When the required program number is reached after adjusting, single click the Confirm button on the operation panel to activate the selection of the current program number, and the green icon “✔” is displayed in the upper right corner, indicating the activation state.



To modify the selected program number, press and hold the Confirm button on the operation panel for more than 0.5 seconds to enter the detailed parameter equipment page. In the preset program mode, you will directly enter the parameter setting page according to the default operating mode set by the system.



The parameters that can be set in different operating modes vary. As shown in the figure above, the default operating mode of S.01 is the continuous mode. In continuous mode, the parameters that can be set only include: Laser power, swing frequency, and swing width.

The parameter range of default operating mode of the system program can be adjusted under the preset parameters. The adjustable parameter range is shown in the following table:

| Operating mode       | Continuous mode | Modulation mode | Pulse mode    | Linear array mode | Timing mode      |
|----------------------|-----------------|-----------------|---------------|-------------------|------------------|
| Adjustable parameter | Power           | Power           | Power         | Power             | Power            |
|                      | Swing frequency | Pulse frequency | Pulse width   | On/off time       | Slow drop time   |
|                      | Swing breadth   | Swing breadth   | Swing breadth | Laser off time    | Time of duration |

After entering the parameter selection page, single click the Confirm button to enter the parameter adjustment operation. The adjustment range of each parameter will vary from each other, while the method of parameter adjustment is the same as that of user parameters adjustment. For the description of parameter adjustment, refer to section 6.2.

You can refer to the following table to quickly select the welding application range of the preset parameters of the system, user parameters

| Preset Parameters Application Quick Query List |                 |       |      |      |      |      |
|--|-----------------|-------|------|------|------|------|
| Material and working mode                      |                 | 0.5mm | 1mm  | 2mm  | 3mm  | 4mm  |
| Stainless steel                                | Continuous mode | S.38  | S.00 | S.02 | S.04 | S.06 |
|  | Modulation mode | S.07  | S.01 | S.03 | S.05 |      |
|  | Wire fill       |       |      | S.28 | S.29 | S.30 |
|  | Spot welding    | S.52  | S.55 | S.54 | S.53 |      |
| Carbon steel                                   | Continuous mode | S.39  | S.08 | S.10 | S.12 | S.14 |
|  | Modulation mode | S.15  | S.09 | S.11 | S.13 |      |
|  | Wire fill       |       |      | S.31 | S.32 | S.33 |
|  | Spot welding    | S.48  | S.51 | S.50 | S.49 |      |
| Aluminum                                       | Continuous mode | S.40  | S.16 | S.18 | S.20 |      |
|  | Pulse mode      | S.21  | S.17 | S.19 |      |      |
|  | Wire fill       |       |      | S.34 | S.35 |      |
|  | Spot welding    | S.45  | S.47 | S.46 |      |      |

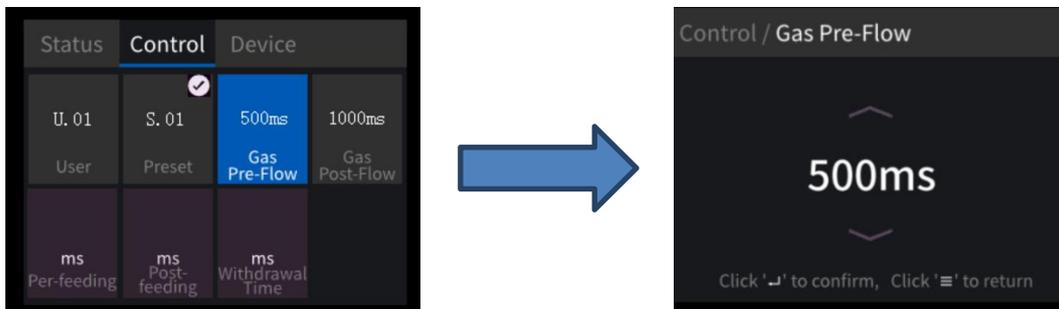
|       |                 |      |      |      |      |  |
|-------|-----------------|------|------|------|------|--|
| Brass | Continuous mode | S.41 | S.22 | S.24 | S.26 |  |
|       | Pulse mode      | S.27 | S.23 | S.25 |      |  |
|       | Wire fill       |      |      | S.36 |      |  |
|       | Spot welding    | S.42 | S.44 | S.43 | S.37 |  |

### 6.3.3 Gas Outlet Delay and Gas Close Delay Setting

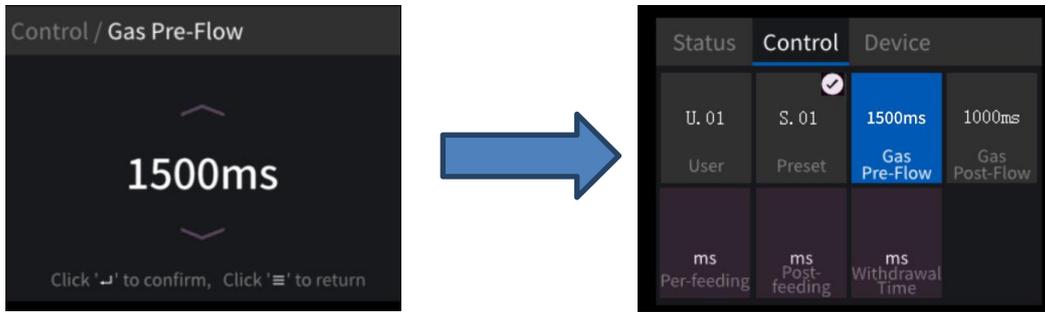
The gas outlet delay and gas close delay are of the global parameters of the system. After the user modifies the parameters, all user programs and preset programs will execute according to the modified parameters. The setting range of gas outlet delay and gas close delay is of 0-3000ms. The setting methods of the two parameters are the same. The setting method of the gas outlet delay is introduced here as an example

Concrete steps for parameter setting:

Use the up or down buttons on the operation panel to switch the page to the control page, click the Confirm button to enter the parameter selection state, select the parameter item "Gas outlet delay" with the up button or down button, and single click the Confirm button to enter the parameter adjustment page

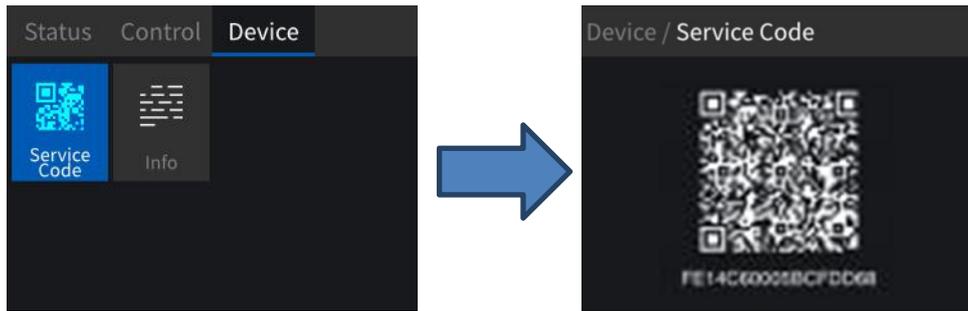


After the gas outlet delay is adjusted to 1500ms, if you do not save the parameter, click the menu key to return to the previous page; if you need to save the modified parameter, single click the confirm button to save the parameter. After the parameter is saved, the parameter value of the gas outlet delay on the control page will be displayed as the modified value.



#### 6.4 Equipment Page Information View

The equipment page contains two options in total, namely "Service Code" and "Equipment Information". After entering this page, single click the "Confirm" button on the operation panel to enter the parameter selection state. You can select parameters by clicking the up button or the down button on the operation panel. When a parameter is selected, the background color will turn blue. After selection, single click or long press the "Confirm" button to enter the parameter setting page.



After entering the equipment page, select "Service code", and single click the Confirm button to enter for viewing



After entering the equipment page, select "Information", and single click the Confirm button to enter for viewing

#### 6.5 Recommended User Parameter Setting

The laser is generally in the continuous mode, and the power slow rise/slow drop time is set to 500ms, which can ensure a better forming effect at the beginning and end of the weld seam.

The larger the swing size of the welding head, the better the adaptability to the gap, but at the same time, it will weaken the energy distribution; similarly, the higher the swing frequency, the lower the energy density. The recommended swing size range is of 2~3mm, and the frequency range is of 50~250HZ.

It is recommended to weld the 1mm thick sheet metal in the focus position, and to weld the 2 mm to 3 mm thick sheet metal by defocusing for -1mm.

The protective gas is an inert gas. The argon or nitrogen is recommended, and argon is preferable. The air pressure is roughly 0.2MPa. Overlarge air pressure will cause the molten pool to be blown and increase the splash, while too low air pressure will fail in providing the protective effect. The gas outlet/close delay is set to 500ms to better protect the weld seam and the welding head lens.

The appropriate welding speed is of 1~6cm/s. Too low speed leads to too large melting width and too large heat-affected zone, which reduces the performance of welded joints; and if the speed is too fast, then it is more difficult to handle.

It is recommended that the thickness of steel sheet to be welded should be of 0~3mm, and the thickness of aluminum and copper sheets should be of 0~2mm. Welding the materials with thickness beyond the said limit range, the weld seam shape and joint performance will worsen.

|                  |                                    |                                      |
|------------------|------------------------------------|--------------------------------------|
| Laser            | Power                              | 0-1500 W                             |
|                  | Fiber core diameter                | 50 μm                                |
| Welding head     | Collimating lens focus length      | 50 mm                                |
|                  | Focusing lens focus length         | 150 mm                               |
| Basic parameters | Swing size                         | 0-5 mm                               |
|                  | Swing frequency                    | 0-300 HZ                             |
|                  | Recommended welding thickness      | Steel ≤3 mm; Aluminum or copper ≤2mm |
|                  | Welding gap requirement            | < 0.5 mm                             |
|                  | Suggested welding speed            | < 10cm/s                             |
|                  | Suggested swing parameters         | 2~3mm, 50~250HZ                      |
|                  | Recommended gas pressure intensity | 0.2MPa                               |

### 6.6 Recommended Welding Parameters for Common Materials

| Material        | Thickness | Connection method | Laser power | Swing size and frequency | Defocusing distance | Speed |
|-----------------|-----------|-------------------|-------------|--------------------------|---------------------|-------|
| Stainless steel | 1mm       | Splice welding    | 60%         | 2mm, 120Hz               | 0                   | 4cm/s |
| Stainless steel | 1mm       | Lap welding       | 80%         | 1mm, 100Hz               | -1                  | 4cm/s |
| Stainless steel | 1mm       | Vertical welding  | 70%         | 2mm, 120Hz               | -1                  | 4cm/s |
| Stainless steel | 2mm       | Splice welding    | 90%         | 2mm, 90Hz                | -1                  | 3cm/s |
| Stainless steel | 2mm       | Vertical welding  | 100%        | 2mm, 90Hz                | -1                  | 3cm/s |
| Stainless steel | 3mm       | Splice welding    | 100%        | 2mm, 60Hz                | -1                  | 2cm/s |
| Stainless steel | 3mm       | Vertical welding  | 100%        | 2mm, 60Hz                | -1                  | 2cm/s |
| Aluminium alloy | 1mm       | Splice welding    | 80%         | 2mm, 120Hz               | 0                   | 4cm/s |
| Aluminium alloy | 1mm       | Vertical welding  | 90%         | 2mm, 120Hz               | 0                   | 4cm/s |
| Aluminium alloy | 2mm       | Splice welding    | 100%        | 2mm, 90Hz                | -1                  | 2cm/s |
| Aluminium alloy | 2mm       | Vertical welding  | 100%        | 2mm, 90Hz                | -1                  | 2cm/s |
| Brass           | 1mm       | Splice welding    | 90%         | 2mm, 120Hz               | 0                   | 4cm/s |

|       |     |                  |      |            |    |       |
|-------|-----|------------------|------|------------|----|-------|
| Brass | 1mm | Vertical welding | 90%  | 2mm, 120Hz | 0  | 3cm/s |
| Brass | 2mm | Splice welding   | 100% | 2mm, 90Hz  | -1 | 1cm/s |
| Brass | 2mm | Vertical welding | 100% | 2mm, 90Hz  | -1 | 1cm/s |

## 7. Troubleshooting/Maintenance

If an alarm is generated, the Error status indicator on the equipment panel will turn on red. There are 44 kinds of possible alarms. It is required to determine which alarm point causes the specific error:

1. Check the laser power display on the front panel. The error code will be displayed on the LCD panel and will begin with the letter "E" followed by three digits (for example, E003 for a 3-digit alarm). Many alarms can be cleared in one of two ways.
2. Restart the welding system after power failure, and the system will first try to automatically clear any alarms. The error should be cleared as soon as the condition that caused it is resolved.
3. Use the HMI software provided by GW to clear the alarm through the computer serial port connection.

Using restart: A small portion of these alarms can only be cleared by restarting the unit. If the conditions that caused it are not resolved, the alarm may occur again. In such cases, please contact the after-sales personnel of GW for help!

For the front panel error display, the severity of the warning increases as the number of errors increases. E027 is more serious than E001. In case of more than one kind of alarm, the one with higher-level severity number will be displayed on the front panel.

### 7.1 Error Message and Troubleshooting

Handheld laser welding system fault alarm code

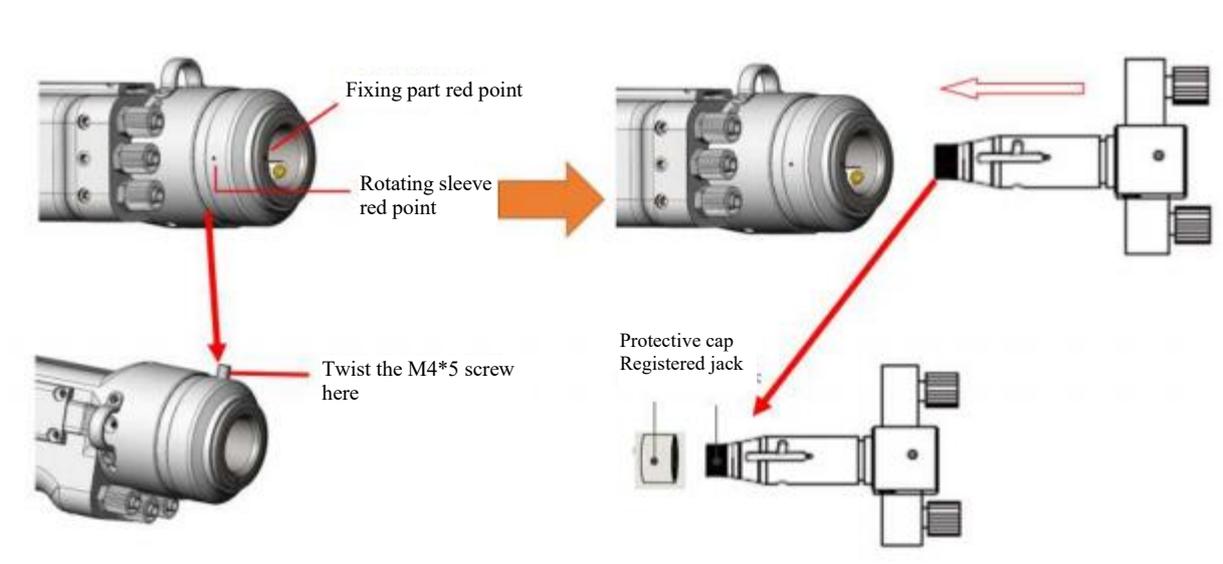
| Code | Description                                     | Handling method   |
|------|---|---|
| S028 | Laser locking                                   | Contact the after-sales personnel of GW   |
| E001 | 1# driver board communication error             | Contact the after-sales personnel of GW   |
| E002 | 2# driver board communication error             | Contact the after-sales personnel of GW   |
| E003 | 3# driver board communication error             | Contact the after-sales personnel of GW   |
| E004 | 4# driver board communication error             | Contact the after-sales personnel of GW   |
| E005 | AD board communication error                    | Contact the after-sales personnel of GW   |
| E006 | Diode module overtemperature                    | Contact the after-sales personnel of GW   |
| E007 | Driver module overheat                          | Contact the after-sales personnel of GW   |
| E008 | Water overheat                                  | Contact the after-sales personnel of GW   |
| E009 | Optical fiber overheat                          | Contact the after-sales personnel of GW   |
| E010 | Laser reflection energy exceeds the upper limit | After the collimator is cleaned, and if the alarm still can not be cleared, please contact the after-sales personnel of GW.                                 |
| E011 | Laser output energy exceeds the lower limit     | After the collimator is cleaned, and if the alarm still can not be cleared, please contact the after-sales personnel of GW.                                 |
| E012 | Diode short-circuit error                       | Contact the after-sales personnel of GW   |
| E013 | Optical fiber disconnection                     | Contact the after-sales personnel of GW   |
| E014 | Overwetting                                     | Confirm the ambient humidity, and if the alarm still can not be cleared, please contact the after-sales personnel of GW<br>Contact GW after-sales personnel |

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|------|--|--|
| E016 | Scram                                  | Press the scram button down, and if the alarm still cannot be cleared, contact the after-sales personnel of GW                                     |
| E017 | Gas pressure fault                     | Contact the after-sales personnel of GW  |
| E018 | Narrow pulse protection                | Contact the after-sales personnel of GW  |
| E019 | Driver plate overvoltage               | Contact the after-sales personnel of GW  |
| E020 | Internal temperature fault             | Contact the after-sales personnel of GW  |
| E021 | Driver short circuit                   | Contact the after-sales personnel of GW  |
| E022 | Fault locking                          | Contact the after-sales personnel of GW  |
| E023 | Heat radiator not activated            | Contact the after-sales personnel of GW  |
| C001 | Control system communication error     | Contact the after-sales personnel of GW  |
| E901 | Heat radiator overcurrent              | Contact the after-sales personnel of GW  |
| E902 | Heat radiator dissynchronization       | Contact the after-sales personnel of GW  |
| E904 | Heat radiator phase loss               | Contact the after-sales personnel of GW  |
| E905 | DC undervoltage                        | Contact the after-sales personnel of GW  |
| E906 | DC overhigh voltage                    | Contact the after-sales personnel of GW  |
| E907 | Temperature sensor over-temperature    | Contact the after-sales personnel of GW  |
| E908 | Temperature sensor error               | Contact the after-sales personnel of GW  |
| E909 | Communication error                    | Contact the after-sales personnel of GW  |
| E910 | AC phase-loss or CT short circuit      | Contact the after-sales personnel of GW  |
| E911 | AC overcurrent                         | Contact the after-sales personnel of GW  |
| E912 | AC input power undervoltage            | Contact the after-sales personnel of GW  |
| E913 | High-voltage switch error              | Contact the after-sales personnel of GW  |
| E914 | IPM over-temperature protection        | Contact the after-sales personnel of GW  |
| E915 | PFC module over-temperature protection | Contact the after-sales personnel of GW  |
| E917 | Diode temperature sensor fault         | Contact the after-sales personnel of GW  |
| E918 | Ambient temperature error              | Confirm the ambient temperature and the ambient humidity, and if the alarm still cannot be cleared, please contact the after-sales personnel of GW |
| E919 | Heat radiator inlet temperature error  | Contact the after-sales personnel of GW  |
| E920 | Heat radiator outlet temperature error | Contact the after-sales personnel of GW  |
| E921 | Diode temperature too low              | Contact the after-sales personnel of GW  |
| E922 | Heat radiator fault                    | Contact the after-sales personnel of GW  |

## 7.2 Welding Head Maintenance and Replacement

Before performing any kind of maintenance on the handheld welding head, the maintenance personnel should turn off the equipment and remove the AC power connection.

On the welding head, turn the silver nut counterclockwise to separate the cable (laser output cable) from the manual welder as shown in the figure below



## 8. Warranty

### 8.1 General Warranty

- a. GW (Shanghai) Laser technology Co., Ltd. guarantees that GW (Shanghai) Laser technology Co., Ltd. has no liens or other encumbrances on the products after the delivery.
  
- b. Unless otherwise stated by GW (Shanghai) Laser technology Co., Ltd., GW (Shanghai) Laser technology Co., Ltd. provides all products with a warranty against material defects and quality problems for a period of 24 months (Counting from the date of delivery). According to the tenth paragraph of the sales terms of GW (Shanghai) Laser technology Co., Ltd., GW (Shanghai) Laser technology Co., Ltd. will choose to 1) repair 2) replace or 3) refund the products that are confirmed defective and still within the warranty period. All repaired or replaced products follow the initial warranty period of the original products that are requested for repair, that is, such repaired or replaced products can enjoy the warranty for free only within the remaining warranty period of the original products that are requested for repair. The buyer must submit a written request for repair within 30 days after any quality problem is found. All requests for repair must be made directly by the buyer, and GW (Shanghai) Laser technology Co., Ltd. will not accept any third party the repair requests.
  
- c. The above requests for repair does not apply to product problems caused by: 1) Incorrect or inappropriate maintenance or calibration made by personnel not from GW (Shanghai) Laser technology Co., Ltd.; 2) Usage of software, interface or power supply provided by the customer or a third party; 3) Unauthorized modification; incorrect operation out of the limit range of product parameters; 4) Abuse, negligence, accident, and loss or damage during transportation; or 5) Unauthorized maintenance or repair.
  
- d. The above warranty regulations are unique. In addition, GW (Shanghai) Laser technology Co., Ltd. will not assume any form of (whether express or implied) written or oral maintenance liability and terms set forth by the regulations or laws. GW (Shanghai) Laser technology Co., Ltd. expressly waives the maintenance liability and terms of implied warranties in the laws, including (but not limited to) the implied warranties of merchantability and applicability.
  
- e) The technical guidance and services provided by GW (Shanghai) Laser technology Co., Ltd. to customers will not affect the warranty terms provided by GW (Shanghai) Laser technology Co., Ltd..

### 8.2 Service and Repair

#### **CAUTION:**

There are no built-in spare parts for user to maintain. All maintenance should be carried out by the personnel of GW (Shanghai) Laser technology Co., Ltd.. Therefore, the repair or replacement requests within the warranty scope must be timely notified to GW or the service representative of your region as soon as the problem is found.

Approved returned products must be placed in a suitable container. If any damage is found upon receipt of the goods, it shall be promptly informed to the carrier in writing.

**IMPORTANT:**

Please do not return the product to GW without returning the Return Material Authorization (RMA). If the warranty period of the product has expired, or the product is no longer within the scope of warranty, the buyer will bear the cost of repair.

### 8.3 Change

We reserve the right to change the design and structure of the product, and we do not assume any responsibility for the modification of product of the same model already sold.

**MEMO:**

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