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Processes



Laser Welding

Description

Handheld Laser Welding Power Source and Torch

OptX™ 2kW

Handheld Laser Welding and Cleaning System



For product information,
Owner's Manual translations,
and more, visit

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OWNER'S MANUAL

From Miller to You

Thank you and congratulations on choosing Miller. Now you can get the job done and get it done right. We know you don't have time to do it any other way.

That's why when Niels Miller first started building arc welders in 1929, he made sure his products offered long-lasting value and superior quality. Like you, his customers couldn't afford anything less. Miller products had to be more than the best they could be. They had to be the best you could buy.

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This Owner's Manual is designed to help you get the most out of your Miller products. Please take time to read the Safety Precautions. They will help you protect yourself against potential hazards on the worksite. We've made installation and operation quick and easy. With Miller, you can count on years of reliable service with proper maintenance. And if for some reason the unit needs repair, there's a Troubleshooting section that will help you figure out what the problem is, and our extensive service network is there to help fix the problem. Warranty and maintenance information for your particular model are also provided.

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Miller is the first welding equipment manufacturer in the U.S.A. to be registered to the ISO 9001 Quality System Standard.



Important Safety Information

Everyone in Laser Controlled Area* Must Read and Observe

All users must review the Owner's Manual in its entirety and be fully trained before using the OptX 2kW System

	Laser Radiation Exposure to laser light can inflict severe retina and/or cornea injuries leading to permanent eye damage and can cause skin damage. Some laser light, including the welding (or cleaning) beam (1070 nm), is invisible. Safety information must be followed to prevent exposure to invisible, direct and reflected beams. The system must only be operated in a Laser Controlled Area (LCA).
	Operation by Minors The OptX system is not intended for use by minors. OptX system is not a toy, presents hazards and should never be used for recreational purposes. Operation of the OptX system in an educational setting should only be permitted under the strict supervision of a trained adult operator who has thoroughly reviewed the Owner's Manual and has articulated to the students all the OptX hazards in the Owner's Manual. Do not leave students unsupervised at any time.
	Eye Damage All persons in the Laser Controlled Area must wear all appropriate personal protective equipment (PPE), including laser safety eyewear, laser welding helmet, heat-resistant gloves, caps, jackets, leather apron and other heat-resistant clothing, to protect against eye damage from any reflected or scattered laser beams as well as welding bright light, ultraviolet (UV) light, heat and sparks. Sleeves and collars should be buttoned at all times. Laser safety eyewear does not protect from direct beam exposure. Never look directly into a laser aperture such as the output fiber or torch when the unit is powered, even if wearing full eye protection. Miller requires to use appropriate laser safety eyewear in combination with Miller OptX helmet. If any PPE becomes damaged or compromised while using the OptX system, discontinue using the OptX system immediately and replace damaged PPE.
	Skin Hazard Exposure to infrared (IR) and ultraviolet (UV) light radiation as well as heat and sparks can cause serious injury to the skin. All persons in the Laser Controlled Area must wear all appropriate personal protective equipment (PPE), including laser welding helmet, heat-resistant gloves, caps, jackets, leather apron and other heat-resistant clothing. Sleeves and collars should be buttoned at all times. Exposure to UV light can cause sunburn and increase a welder's risk of skin cancer and accelerated signs of skin aging. Welding sparks can cause burns as well as contacting to hot surface or exposure to thermal radiation or hot particles. Avoid touching the welded part or the torch nozzle tip and/or tube, with unprotected skin, immediately and shortly after laser emission. Miller requires to use appropriate laser safety eyewear in combination with Miller OptX helmet. If any PPE becomes damaged or compromised while using the OptX system, discontinue using the OptX system immediately and replace damaged PPE. Laser beam can penetrate through metal parts to objects or persons on the other side. Never hold parts for processing in a position where laser penetration of the metal can result in a hazard.

* As defined by ANSI Z136.1 and IEC 60825-1, a Laser Controlled Area is "a laser use area where the occupancy and activity of those within is controlled and supervised. This area may be defined by walls, barriers or other means. Within this area, potentially hazardous beam exposure is possible." Laser controlled areas are generally enclosed areas capable of absorbing stray laser energy and equipped with a safety interlock to the laser to prevent unauthorized access while laser is in use.

Important Safety Information (cont.)

Everyone in Laser Controlled Area* Must Read and Observe

All users must review the Owner's Manual in its entirety and be fully trained before using the OptX 2kW System

	Reflected Beam Hazard Highly reflective metals such as aluminum, copper and copper alloys can cause reflection of the laser energy away from the target weld site to the laser source or surrounding area and can present a hazard. Stray reflections can also damage materials, components or equipment nearby to the laser processing area. All persons in the Laser Controlled Area must wear all appropriate personal protective equipment (PPE), including laser safety eyewear, laser welding helmet, heat-resistant gloves, caps, suits, leather apron and other heat-resistant clothing, to protect against eye damage from any reflected or scattered laser beams as well as welding bright light, ultraviolet (UV) light, heat and sparks. Sleeves and collars should be buttoned at all times.
	Fume Hazards Welding fumes from interaction of the laser beam with target materials can be comprised of very fine particles. FUMES AND GASES can be hazardous. Welding produces fumes and gases. Breathing these fumes and gases can be hazardous to your health. Keep your head out of the fumes. Do not breathe the fumes. Ventilate the work area and/or use local forced ventilation at the weld to remove welding fumes and gases. The recommended way to determine adequate ventilation is to sample for the composition and quantity of fumes and gases to which personnel are exposed. If ventilation is poor, wear an approved air-supplied respirator. Read and understand the Safety Data Sheets (SDSs) and the manufacturer's instructions for adhesives, coatings, cleaners, consumables, coolants, degreasers, fluxes, and metals. During welding, always keep your head away from fumes. Always weld in an area with adequate ventilation and use a fume extraction system to remove vapors, particles, and hazardous debris from the welding processing area.
	Other Hazards Laser radiation (both reflected and scattered), and heat and sparks produced during laser material processing can start a fire or cause an explosion in combustible or flammable materials in the Laser Controlled Area. Laser welding and cleaning must only be performed in an area free of combustible or flammable materials. Never weld or clean parts on containers that have flammable or combustible material. WELDING can cause fire or explosion. Welding on closed containers, such as tanks, drums, or pipes, can cause them to blow up. Sparks can fly off from the welding. The flying sparks, hot workpiece, and hot equipment can cause fires and burns. Accidental contact of electrode to metal objects can cause sparks, explosion, overheating, or fire. Check and be sure the area is safe before doing any welding. Remove all flammables within 35 ft (10.7 m) of the weld. If this is not possible, tightly cover them with approved covers. Do not weld where flying sparks can strike flammable material. Protect yourself and others from flying sparks and hot metal. Be alert that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Watch for fire, and keep a fire extinguisher nearby. Beware that welding on a ceiling, floor, bulkhead, or partition can cause fire on the hidden side. CYLINDERS can explode if damaged. Compressed gas cylinders contain gas under high pressure. If damaged, a cylinder can explode. Since gas cylinders are normally part of the welding process, be sure to treat them carefully. Protect compressed gas cylinders from excessive heat, mechanical shocks, physical damage, slag, open flames, sparks, and arcs. Install cylinders in an upright position by securing to a stationary support or cylinder rack to prevent falling or tipping. Keep cylinders away from any welding or other electrical circuits. Never drape a welding torch over a gas cylinder. Never allow a welding electrode to touch any cylinder. Never weld on a pressurized cylinder—explosion will result. Use only correct compressed gas cylinders, regulators, hoses, and fittings designed for the specific application; maintain them and associated parts in good condition. Turn face away from valve outlet when opening cylinder valve. Do not stand in front of or behind the regulator when opening the valve. Keep protective cap in place over valve except when cylinder is in use or connected for use. Read and follow instructions on compressed gas cylinders, associated equipment, and Compressed Gas Association (CGA) publication P-1 listed in Safety Standards.

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Preface

Ensure you read and understand this manual in its entirety and familiarize yourself with the operating and maintenance instructions before you use the product.

Miller strongly recommends that all operators of the product read and pay particular attention to all safety information contained herein prior to operating the product.

IMPORTANT

This Owner's Manual should stay with the product to provide you and all future operators, users, and owners of the product with important operating, safety and other information. It should be referred to regularly.

For product technical assistance, contact Miller Customer Service.

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Audience

This manual is intended for all owners and operators of the **OptX** system, as well as all persons working in the vicinity of the product when it is in use. Use of this product should be limited to fully trained industrial, professional or commercial operators who are responsible for welding in industrial and non-industrial installations for commercial purposes.

All users of this product must be trained in both welding and laser safety, and must follow all instructions and safety warnings in the Owner's Manual, safety labels on the OptX system, and all applicable safety standards, laws and regulations, including:

In the United States:

- ANSI Z136.1 - American National Standard for Safe Use of Lasers
ANSI Z49.1 - Safety in Welding, Cutting, and Allied Processes
You can obtain a copy of the safety standards through the ANSI webstore at:
<https://webstore.ansi.org/>
- OSHA, Occupational Safety and Health Standards for Food and Drugs, Title 21 Code of Federal Regulations (CFR) Chapter I, Subchapter J, 1040.10 Laser products.
OSHA, Technical Manual (OTM), Section III: Chapter 6, Laser Hazards
You can obtain a copy of the OSHA standards at:
<http://www.osha.gov/>

In the European Union:

- IEC 60825-1:2014 - Safety of Laser Products - Part 1: Equipment classification and requirements.
IEC 60825-4 - Safety of Laser Products - Part 4: Laser Guards
Standards can be found through the IEC webstore at:
<https://www.iec.ch/homepage>
- Directive 2006/25/EC - Artificial Optical Radiation. Directive is found at:
<https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:114:0038:0059:en:PDF>
- ISO 11553-2 - Safety of machinery - Laser processing machines - Part 2: Safety requirements for hand-held laser processing devices. Standard is found at:
<https://www.iso.org/home.html>
- **In Germany:** TRGS 900 and TRGS 910 (exposure limit values for hazardous substances). Standards can be found through the website:
https://www.baua.de/DE/Home/Home_node.html

We strongly recommend that all operators obtain appropriate laser safety training before operating this product. Laser training resources are provided in Section 2.8 [▶ 54] of this manual.

The OptX-Series is not intended for use in residential settings or by untrained operators in any setting.

Note

The language of the original instructions is English.

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1 Overview

1.1 Introduction

Miller Electric introduces the **OptX** series fiber laser system that consists of a compact weld control unit and an ergonomic, lightweight handheld torch with built-in beam wobble functionality. The fiber laser source provides up to 2000 W maximum output power at 1070 nm infrared wavelength. Select stored program modes enable up to 3000 W of High Peak Power for additional capability.

The **OptX** series fiber laser system provides both welding and cleaning capabilities. For welding, the system provides an adjustable width up to 5 mm. When operating in laser cleaning mode, the system provides an adjustable width up to 15 mm. The cleaning mode is used to remove oils, rust, contaminants and coatings before welding, and remove soot, debris and discoloration after welding. This will improve the visual appearance of the weld joint without the time and expense of abrasives and chemicals. In addition, the **OptX** system can weld an extended range of material thicknesses as well as reflective materials.

The Miller fiber laser welding system has been designed and tested with safety in mind. By following this Owner's Manual and applying sound laser safety practices, it can be a safe and reliable device.

Because of its special characteristics, laser light poses safety hazards different than light from other sources. Laser radiation can be dangerous for the eye and also for the skin if the irradiance of directly propagated, specularly reflected or even scattered radiation is high enough. All laser operators and persons in the vicinity of the laser when the laser is in use must be aware of the hazards and wear all recommended personal protective equipment and must follow all safety procedures provided / recommended during equipment use.

In order to ensure the safe operation and optimal performance of the product, follow all instructions in this manual and adhere to all safety and related warnings.

These safety precautions must be observed during all phases of operation, maintenance, and repair of this instrument.

Operators are urged to adhere to these recommendations and to apply sound laser safety practices at all times. Furthermore, operators should review all safety guidelines and requirements for welding.

1.2 Types of Use

1.2.1 Intended Use

The **OptX** series system has been designed solely for use by fully trained industrial, professional or commercial operators who are responsible for welding in industrial and non-industrial installations for commercial purposes.

All **OptX** series models are used for welding and brazing applications. **OptX** models, in addition, can be used for pre- or post-weld surface cleaning and welding up to 0.313 inch plate thickness parts.

Product intended use is limited to metals materials processing such as: stainless steel, galvanized steel, mild steel, and aluminum. The **OptX** model, in addition, is recommended for welding of reflective materials such as aluminum 6XXX, nickel alloys, titanium, brass and copper parts.

- Metal Fabrication Shops
- Auto Body Applications
- Construction and piping
- Maintenance and Repair
- Aerospace and Transportation
- Farm, furniture and appliances

1.2.2 Non-Intended Use (Foreseeable Misuse)

Use of this product should be limited to fully trained industrial, professional or commercial operators who are responsible for welding in industrial and non-industrial installations for commercial purposes. The device is to be used exclusively in the intended operation according to section 1.2.1 [►17].

All users of this product should be trained in both welding and laser safety, and must follow all instructions and safety warnings in the Owner's Manual, safety labels on the OptX device, and all applicable safety standards, laws and regulations.

Examples of product misuse include the following:

1. Use of this product by untrained persons in any area.
2. Inadequate safeguards at the working site.
Key safeguards include: (1) Establishing a Laser Controlled Area with an inter-locked entrance; (2) Providing PPE for all persons within the laser controlled area (e.g. laser safety eyewear, welding helmet with adequate filters and face shield, heat-resistant clothes, gloves and apron).
3. Unauthorized modification or conversion of the product by the user or other personnel without the express written permission of Miller Electric Mfg. LLC.
4. Intentionally disabling or by-passing product safety systems.
5. Using parts and consumables (other than PPE that meets safety requirements) from other manufacturers (e.g. protective window, nozzle tips, etc) which do not meet minimum requirements.
6. Using this product to weld parts that contain materials other than those described in section 1.2.1 [►17] above.
7. Removing or defacing safety labeling and hazard notices.
8. Holding parts in hand or in any manner where the torch is pointed in the direction of any individual's body parts.
9. Use of this product by any individual in residential area.
10. Welding on containers that contain flammable, combustible or unknown materials.

1.3 Target Groups

This manual for the product **OptX** has been created by Miller for the operating and maintenance personnel of the product owner.

1.4 Personnel Qualifications

The areas of responsibility, ensuring the necessary competence and supervision of personnel must be precisely regulated by the product owner.

The personnel assigned to install, operate, and maintain the product must have the corresponding qualifications for performing this work. Any lack of knowledge on the part of the personnel must be corrected through training and instruction.

1.4.1 Professional Qualification

Professional qualifications are a necessary prerequisite for certain work on the product. Depending on the respective work, the corresponding product-specific qualification is also required.

Electrician

Electrical specialists include professionally trained personnel with the appropriate knowledge and experience. They are permitted to carry out electro-technical work, to assess it and recognize any potential hazards involved.

Laser Safety Officer

Laser Safety Officer include professionally trained personnel with the appropriate experience and qualification. They are responsible for conformance and enforcement of laser safety regulations. Successful participation in the training must be confirmed by an examination certificate. For further information follow the local regulations.

1.4.2 Product Specific Qualification

Product-specific qualifications are obtained during training and instruction on the product. Depending on the product-specific qualification acquired, personnel are divided into the following groups:

Operating Personnel

The operating personnel was trained and instructed in the safe operation of the product.

The operating personnel may only:

- Perform welds using preset programs
- Perform cleaning using preset programs

Advanced Operating Personnel

The advanced operating personnel may

- Create User Mode Weld Programs (welding/cleaning programs)
- Adjust preset welding and cleaning programs
- Select and install the torch nozzle tip and tube
- Set up global device parameters

Maintenance Personnel

The maintenance personnel is made up of staff who have the corresponding professional and product-specific qualifications to perform the tasks listed below.

The maintenance personnel are trained in the maintenance of the product by Miller or another responsible Miller subsidiary or authorized to carry out the maintenance work, insofar as this is not carried out by employees of Miller.

The following tasks are performed by the maintenance personnel:

- Assembly and installation
 - Setting up the Laser Controlled Area
 - Set up and install the product
 - Run lines and fibers to the product

- Connect the product (the power supply must be connected by an electrician)
 - Decommission the product
- Maintenance Work
 - Replace protective window
 - Replace focus lens
 - Clean the fiber cable terminator (quartz block of the fiber connector)
 - Replace the torch
- Troubleshooting
 - Run diagnostics
 - Troubleshooting as described in the manual (refer to chapter 10 [▶151])

1.5 Overview Task / Qualification

▼ Table 1. Overview of Tasks and Personnel Qualification

Task	Chapter in the Manual	Qualification
Operating Laser Welder: Welding and cleaning using preset programs	5.9 [▶90] System Startup 5.10 [▶91] System Shutdown 7.4 [▶112] Quick Start Welding Using Preset Programs 7.5 [▶115] Quick Start Cleaning Using Preset Programs	Operating Personnel
Operating Front Panel Controls: - Set up laser power, wobble frequency, wobble length - Select and use weld program mode - Set up global device parameters	6.1 [▶93] Rotary Control Knobs 6.2 [▶94] Program Mode Weld Program Selection Buttons 6.3 [▶96] Device Front Panel Setup Mode	Advanced Operating Personnel
Operating Laser Welder: Select and install torch nozzle tip and tube	7.3 [▶107] Torch Nozzle Tip and Tube	Advanced Operating Personnel
Setting weld programs and parameters	8 [▶119]. Weld Programs and Parameters	Advanced Operating Personnel
Setting up - global device parameters - weld programs and parameters	9 [▶127]. Computer Connection to Device	Advanced Operating Personnel

▼ Table 1. Overview of Tasks and Personnel Qualification (Continued)

Task	Chapter in the Manual	Qualification
Installing Laser Welder: - Connect customer interface - Connect electrical power	5.1 [▶77] Precautions 5.2 [▶78] Air Flow and Installation Clearances 5.3 [▶78] Connect Workpiece Clamp Cable 5.4 [▶79] Connect Welding Gas 5.5 [▶79] Connect Torch I/O Cable 5.6 [▶80] Customer Interface Connections 5.7 [▶82] Connect Electrical Power 5.8 [▶84] Laser Controlled Area Door Interlock Example 5.9 [▶90] System Startup 5.10 [▶91] System Shutdown	Maintenance Personnel + Electrician
Establish a Laser Controlled Area	2.5.1 [▶50] Establish a Laser Controlled Area	Maintenance Personnel + Laser Safety Officer
Identify and clear errors	10 [▶151]. Troubleshooting	Maintenance Personnel
Decommissioning Welder Device	11 [▶167]. Decommissioning Welder Device	Maintenance Personnel
Maintenance Work	A.1 [▶155] Torch Maintenance A.1.4 [▶160] Replacing the Torch A.2 [▶161] Connect/Disconnect Fiber Output A.3 [▶165] Output Termination Cleaning Procedure	Maintenance Personnel

1.6 Certification

Miller certifies that this instrument has been thoroughly tested and inspected. It was found to meet published specifications prior to shipping.

1.7 Models Covered

Miller system models covered by this document include:

- OptX 2kW

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2 Safety and Compliance Information

2.1 Safety Information

To ensure the safe operation and optimal performance of the **OptX** device and associated peripherals, follow all warnings in the product Owner's Manual.

Safety precautions must be observed during all phases of operation, maintenance, and service.

Operators must adhere to these recommendations and apply sound laser safety practices at all times. There are no user serviceable parts, equipment or assemblies associated with this product, except as indicated in Section A [▶155]. All internal service and maintenance should only be performed by qualified Miller personnel, except as noted in Section A [▶155].

2.1.1 Safety Signal Words and Symbols

Safety warning notes throughout this Owner's Manual are introduced with specific signal words (e.g. **DANGER**, **WARNING**, **CAUTION** and **NOTICE**) and supplementary safety symbols. They are designed to call your attention to any hazards or important information. These standardized signal words will identify levels of hazards and risks for injury or property damages.

Refer to Table 2 [▶24] for the list of signal words and their meanings.

Refer to Table 3 [▶25] for a list of all the symbols and their meanings.

Safety warning messages will appear in this Owner's Manual wherever hazards or hazardous situations can occur. They will alert the user to direct and indirect hazards concerning the use of the product and associated peripherals, and contain general rules of behavior.

Safety warning messages will (1) identify what the hazard is, (2) specify what the consequences will be if the hazard is not avoided and (3) specify what precautions should be taken.

For your safety, it is important to read and fully understand the meaning of these signal words and symbols. Follow all safety warnings and proceed with caution to avoid accidents, personal injury, and damage to property.

An example of a safety warning note is shown here.

 **DANGER**



Class 4 laser radiation

Severe and permanent eye damage from reflected or scattered radiation.

- Protective laser eyewear must be worn inside the laser area if the system can be active (Keyswitch turned ON).
-

The table below lists the signal words used in this manual.

▼ *Table 2. Signal Words Used in this Owner's Manual*

Signal Word ¹	Explanation
 DANGER	• This signal word indicates an immediate danger. If this danger is not avoided, this will lead to death or severe injuries.
 WARNING	• This signal word indicates a possible danger. If this danger is not avoided, this could lead to death or severe injuries.
 CAUTION	• This signal word indicates a possible dangerous situation. If this dangerous situation is not avoided, this could lead to light or moderate injuries.
NOTICE	• If this notice is not heeded, there is a risk of damage to the product, or other property damage or environmental damage.
IMPORTANT	• This signal word indicates important information or recommendations concerning the subject under discussion (not hazard related). Do not overlook this information.

¹. Do not proceed until you fully understand and meet all the required conditions.

The table that follows lists the symbols used throughout this manual.

▼ Table 3. Safety Symbols Used in this Owner's Manual

Symbols	Explanation	Symbols	Explanation
WARNING HAZARD SYMBOLS:		MANDATORY SYMBOLS:	
	ELECTRICAL HAZARD Indicates presence of dangerous voltages that can be of sufficient magnitude to constitute a risk of electric shock in certain conditions.		NOTICE SYMBOL Symbol is used in conjunction with the NOTICE signal word. Notices are related to various kinds of property damages. Ensure you do not overlook this information.
	LASER RADIATION HAZARD Indicates a danger of exposure to hazardous invisible and visible laser radiation.		LASER CONTROLLED AREA SYMBOL This symbol is not defined in a standard. It was created to illustrate that the product must only be operated within a Laser Controlled Area (or room) where the occupancy and activity of those within is controlled and supervised. Within this area, potentially hazardous beam exposure is possible. Laser controlled areas are generally enclosed areas capable of absorbing stray laser energy and equipped with safety interlock to the laser to prevent unauthorized access while the laser is in use. Personnel inside the LCA must be wearing all laser safety PPE.
	OPTICAL RADIATION HAZARD Indicates that operator must take precautions to avoid injury to eyes and skin from optical radiation (such as UV, visible or IR) that is produced during laser processing.		WEAR LASER PROTECTIVE EYEWEAR Symbol indicates that personnel must wear laser safety eyewear (PPE) to protect against laser radiation hazards.
	CAUTION HAZARD SYMBOL General purpose hazard symbol to call your attention to a particular hazard.		WEAR WELDING MASK / HELMET This symbol indicates that personnel must wear a welding helmet to protect their eyes and head. There can be hot flying particles, intense IR and UV radiation from welding activity.
	DIRECT AND REFLECTED LASER BEAM HAZARD Symbol illustration shows a reflected laser beam from the part surface that is directed towards the operator's head/body. This symbol was created to warn of a potential eye or skin hazard due to direct or reflected laser beams during welding (or cleaning). Personnel must wear protective equipment and clothing. The laser operator must consider cone of reflection and maintain proper position during operation to ensure no part of their head or body intersects with the reflection zone.		WEAR PROTECTIVE GLOVES Symbol indicates that personnel must wear heat-resistant protective gloves.

▼ Table 3. Safety Symbols Used in this Owner's Manual (Continued)

Symbols	Explanation	Symbols	Explanation
WARNING HAZARD SYMBOLS:		MANDATORY SYMBOLS:	
	DIRECT BEAM POINTING IS PROHIBITED Symbol illustration shows the handheld laser torch being pointed towards person's head. Symbol warns user to NEVER look directly into the output of the torch or point the handheld torch at others. This is dangerous, even when wearing full eye protection.		WEAR PROTECTIVE CLOTHING Symbol indicates that personnel must wear heat-resistant protective clothing.
	FIRE HAZARD Symbol indicates a possible fire hazard. Operators must take precautions to avoid causing a fire by igniting flammable material.		WEAR PROTECTIVE APRON Symbol indicates that personnel must wear heat-resistant protective apron.
	HOT SURFACE HAZARD Symbol indicates hot surface during welding. To avoid possible burns protective gloves and clothing should be worn.		WEAR RESPIRATORY PROTECTION Symbol indicates that respiratory protection must be worn.
	GAS CYLINDER HAZARD Symbol indicates exploding pressurized cylinder. The gas cylinder must be protected from high temperatures, sparks, and flames. Cylinder should be secured to prevent it from tipping over.		MUST SECURE GAS CYLINDERS Symbol indicates that all gas cylinders must be secured upright to prevent them from tipping over and to avoid flammable or explosive vapors being released.
	FUME INHALATION HAZARD Symbol indicates a inhalation health hazard. Personnel should take precautions to protect themselves from being exposed to hazardous and toxic fumes produced during welding.		READ OPERATING MANUAL INSTRUCTIONS Symbol indicates that personnel must read safety and operational instructions in this manual.
	WARNING ASPHYXIATING ATMOSPHERE HAZARD Symbol indicates a build up of toxic gases and fumes that can cause unconsciousness, asphyxiation or death.		
	HEAVY WEIGHT HAZARD Symbol warns that physical injuries are possible due to heavy weight.		

2.2 Laser Safety Information

2.2.1 Key Control

The keyswitch, on the front panel of the device, limits access to the laser device and can prevent an unauthorized user from turning the laser device on. In order for the laser to operate, the key must be inserted into the keyswitch and turned to the 1 (ON) position (refer to section 3.2 [▶63]). Once turned to the ON position the key cannot be removed until turned OFF.

WARNING



Class 4 invisible laser radiation

Severe and permanent eye damage from reflected or scattered radiation.

- ▶ Protective laser eyewear must be worn inside the laser area if the system can be active (Keyswitch turned ON).
- ▶ When the Operator of the laser device stops working and prior to leaving the Laser Controlled Area, the Operator must: (1) turn keyswitch to OFF, and (2) remove the key and store it in a secure location. This prevents unauthorized and untrained personnel from using the laser device.

2.2.2 Emission-ON Safety Indicators

The laser device is equipped with an Emission-On status indicator light located on the front panel of the unit (refer to section 3.2 [▶63]). When this status indicator light turns on (during welding or cleaning), it means that laser emission was initiated by the operator controls on the handheld torch.

If the laser aperture or a remote laser control is located more than 2 meters (6.5 feet) from the indicator on the front panel, then an additional indicator must be located at the aperture or remote control location (this is requirement in EN 60825-1).

DANGER



Danger when the power supply (PS) is activated

The laser device is in a danger state and all precautions must be taken as if the laser is ready to emit.

- ▶ The signals *Power Supply Enabled* and *Switch Enabled* on the 12-pin Interface Connector should be used for a laser radiation emission warning device.

The handheld laser torch which can be 10 meters (32 feet) away from the unit front panel display, has an additional emission ON status indicator light on the torch itself that will be lit red while laser emission is turned ON (refer to section 3.4 [▶67] and 7.1.9 [▶105]).

The power supply that controls emission has two enables. One is called Power Supply Enable and the other is called Switch Enable.

On the 12-pin interface connector, pins 5,6 (signal *Power Supply Enabled*) and 7,8 (signal *Switch Enabled*) can be used to control an external warning device according to the requirements on EN 60825. The warning device shall warn that the laser is powered on, ready and capable of emitting. Full precautions must be taken.

2.2.3 Laser Classification

Governmental standards require that all lasers be classified according to their output power or energy and the laser wavelength. This device is classified as a high power laser instrument with laser classification for each laser type identified in Table 4 [► 28].

IMPORTANT

This product emits two types of laser radiation output

- **Primary Laser:** This is the material processing laser (Class 4, high power fiber laser) which is used for welding (or cleaning). The emitted laser output is INVISIBLE.
- **Guide Laser:** The guide laser (Class 2M) emits a VISIBLE red output beam that is used by the Operator as a visual aid when positioning the laser torch nozzle onto the parts prior to starting the welding (or cleaning) process. Picture on the right shows the red guide beam over the seam of the two plates prior to welding.



▼ Table 4. Laser Classification Information

Characteristic	Primary Laser ³ fiber laser used for welding/cleaning	Guide Laser ⁴ aids in positioning laser torch nozzle
Laser Classification		
European Union	Class 4 (per EN 60825-1)	Class 2M (per EN 60825-1)
United States	Class IV - (i.e. Class 4) ¹ (per 21 CFR, Subchapter J, part II, 1040.10(d))	Class II - (i.e. Class 2) ¹ (per 21 CFR, 1040.10(g))
Wavelength	1070 nm	600 to 700 nm
Laser Radiation Emitted	INVISIBLE (IR)	VISIBLE (Red)
Average Power	² greater than 2000 W	1 mW
Peak Power	² greater than 3000 W	1 mW

¹ US laser classification uses roman numerals (i.e. IV = 4, and II = 2).

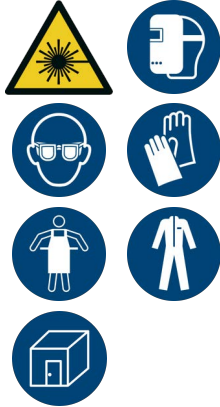
² **Primary Laser:** Total light power radiated from the optical output is greater than 2000 W average and greater than 3000 W peak per optical output port, depending on the model. Refer to the product specification for the specific performance characteristics of your device.



³ **Primary Laser:** Class 4 high power lasers present the most serious of all laser hazards. **Diffuse and specular beam reflections can inflict severe retina and/or cornea injuries leading to severe and permanent eye damage. Class 4 laser beams are also a potential skin hazard and fire hazard as well.** Take precautions to prevent accidental exposure to both direct and reflected beams and also against diffusely scattered radiation.

⁴ **Guide Laser:** **Eye exposure should be avoided. Do not stare into beam or view directly with optical instruments.**

DANGER



Class 4 invisible laser radiation. Eye and skin hazards.

This level of light can cause severe damage to the eyes and skin.

- Due to these risks a qualified laser safety officer should be present to ensure a safe working environment. Refer to section 2.5.1 [▶50] for information on establishing a Laser Controlled Area.
- Protective laser eyewear must be worn within the Laser Controlled Area if the system can be active (Keyswitch turned to ON position).
- Appropriate laser safety protection, guards and procedures shall be in place at all times while the laser device is operational.
- All persons in the Laser Controlled Area must wear all recommended PPE, including: (1) specified laser safety eyewear, and (2) welding helmet with appropriate filters and face shield. For more information refer to sections 2.2.4 [▶29], 2.4.1 [▶42] and 2.4.2 [▶42].
- Additional PPE to protect against skin hazards includes heat-resistant protective gloves, suit, and apron. Refer to section 2.4.3 [▶43].
- **In the EU** refer to: Directive 2006/25/EC - artificial optical radiation
- **In Germany** also refer to: (1) TROS IOS - Technical Rules for Occupational Safety and Health Ordinance on Artificial Optical Radiation - TROS Incoherent Optical Radiation; and, (2) Technical Rule for Occupational Safety and Health Ordinance on Artificial Optical Radiation - TROS Laser Radiation

WARNING



Improper use of this laser system

Use of controls, adjustments or performance of procedures other than those set forth in this Owner's Manual can result in exposure to hazardous radiation.

- Be sure to read this Owner's Manual and follow all of the instructions.

Refer to the laser safety warning labels in section 2.2.7 [▶35].

2.2.4 Laser Safety Eyewear and Welding Helmet

IMPORTANT

- Laser safety eyewear must conform to US and international safety standards. The regulations in force will depend on the location of the laser installation.
- **In the US** refer to: (1) 29 CFR 1926.102(c)(2); and (2) ANSI Z136.1.
- **In the EU** refer to: (1) Regulation (EU) 2016/425 on personal protective equipment; and also (2) EN 207 Personal eye-protection equipment - Filters and eye protectors against laser radiation (laser eye-protectors).
- **In Germany** also refer to: DGUV Information 203-042 (Selection and use of laser safety goggles, laser adjustment goggles and laser protective shields).

The selection of appropriate laser safety eyewear requires the end user to accurately identify the range of wavelengths emitted from this product and the Foreseeable Exposure Limits (FEL). Review the safety labeling on the product and verify that the personal protective equipment (i.e. eyewear, enclosures, viewing windows, or viewports, 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 (or cleaning) process radiation and UV radiation (see section 2.4.1 [▶42]).

Protective eyewear is made possible with the use of filters which can transmit or attenuate a particular wavelength of light, partially or completely. The Optical Density (OD) of a filter is a measure of this attenuation of energy passing through the filter. The higher the OD value, the higher the attenuation and the greater the protection value (more of the light of a particular wavelength is being filtered). In addition, the protective eyewear must provide a sufficient resistance against the FEL (i.e. it must withstand a direct hit from the laser for at least 5 second according to EN 207).

WARNING



Eye hazards during laser welding

Risk of permanent eye damage and vision impairment from invisible reflected and scattered Class 4 laser beams. Also risk of eye damage as a result of exposure to UV light, heat and sparks produced during the welding process.

- Operators and persons in the vicinity must use the specified laser safety eyewear in combination with a welding helmet having appropriate filters and face shield when the device is in operation.
- Laser safety eyewear alone do not provide sufficient eye protection when **OptX** device is in use.
- Laser safety eyewear must have an optical density 7 or greater at a nominal laser wavelength of 1070 nm.
- The welding helmet must be capable of withstanding a specular laser reflection of full power and nominal working distance for a time duration long enough to avoid injury.

IMPORTANT



- Miller is providing one pair of laser safety eyewear and one carbon fiber welding helmet with the unit. This safety equipment must be worn while operating the device, as well as by any individuals in the vicinity of this device while in operation.
- Refer to the Accessories Table 15 [▶61] for list of part numbers. Additional laser safety eyewear and carbon fiber welding helmet are available for purchase.
- Do not use with laser safety eyewear other than those listed on Table 15 [▶61] as injury can result.

DANGER



Incorrect or damaged laser safety eyewear

Severe and permanent eye damage and vision impairment can occur.

- Laser safety eyewear must have an optical density 7 or greater at a nominal laser wavelength of 1070 nm.
- Before using a pair of laser safety eyewear, all personnel must check the labeling on the eyewear and confirm that they meet the requirements specified above.
- Prior to use, the laser safety eyewear should be inspected to check for any cracking, discoloration, coating damage, pitting, and crazing. Also check the mechanical integrity of the frame.
- If the condition of the laser safety eyewear is suspect, that pair should be discarded and replaced.

Whether the laser is used in a new installation or to retrofit an existing system, the end user is solely responsible for determining the suitability of all personal protective equipment (except for PPE provided by Miller). There are several laser safety equipment suppliers in both Europe and the US that offer materials or equipment (refer to Table 5 [▶31]).

▼ Table 5. Laser Safety Equipment Suppliers

Item	Organization ¹
European Union: ²	
1	Laservision https://www.uvex-laservision.de/laserschutzbrille
2	Protect Laserschutz https://protect-laserschutz.de/Laserschutzbrillen
3	Laser 2000 https://www.laser2000.de/de/2022-laserschutzbrillen
4	Spetec https://www.spetec.de/downloads/Preisliste_Laserschutzbrillen-Spetec.pdf
United States: ²	
5	Laservision USA https://lasersafety.com
6	Kentek Corporation https://kenteklaserstore.com https://www.kenteklaserstore.com/lightweld-class-4-laser-safety?utm_source=pd
7	Rockwell Laser Industries https://rli.com

1. Miller provides the names of these providers solely as a convenience and does not endorse or recommend any of them, or their products or services. Miller assumes no liability for their recommendations, products or services.
2. This list is not necessarily complete.

2.2.5 Heat-Resistant Clothing PPE

Refer to section 2.4.3 [▶43] for skin hazard related information. Unprotected skin of personnel can be exposed to hazardous levels of the laser radiation, UV and blue light process related radiation and burns due to hot parts.

To protect against skin hazards, the Operator of the handheld laser device must wear heat-resistant gloves, clothing, caps and apron while the device is in operation. Refer to table for recommended supplier.

Protective gloves must resist against laser radiation of 1070 nm before exceeding the maximum permissible exposure skin value. Protective gloves must be suitable for use according to the welding protection standard EN ISO 11611. They must also be suitable for use according to heat and flame protection standard EN ISO 11612.

▼ Table 6. Heat Protective Clothing Suppliers

Item	Organization ¹
European Union: ²	
1	Protect Laserschutz https://protect-laserschutz.de
2	Jutec https://jutec.com

1. Miller provides the names of these providers solely as a convenience and does not endorse or recommend any of them, or their products or services. Miller assumes no liability for their recommendations, products or services.

2. This list is not necessarily complete.

2.2.6 Laser Technical Data and Safety Hazard Calculations

Relevant laser specifications for the product are indicated in Table 7 [►32].

▼ Table 7. Laser Technical Data

Characteristic	OptX 2kW
Operating Mode	CW ¹ or HPP ²
Wavelength	1070 nm
Maximum Average Power (in CW Mode)	2200 W
Maximum Pulse Energy (in HPP Mode)	16.5 J
Pulse Duration (in HPP Mode)	5 ms
Beam Divergence ³	32.4 mrad

1. Continuous Wave (CW): Laser emits a continuous and steady emission output (i.e. emission is not pulsed). The optical power is constant with time.

2. High Peak Power (HPP): HPP laser mode enables a CW laser to operate in pulsed mode but with an increased peak power compared to the average power in CW mode.

3. Related to 86% of the total power.

The site Laser Safety Officer (LSO) will need to identify the maximum permissible exposure and the hazard distances in order to determine what PPE, guards and other safety procedures are required to be able to safely operate the product within the Laser Controlled Area (LCA).

- Refer to Table 8 [►33] for listing of key laser safety terms and their definitions.
- Refer to Table 9 [►34] for calculated MPE's, NOHD and NHZ. There are separate values specified for eye and for skin.

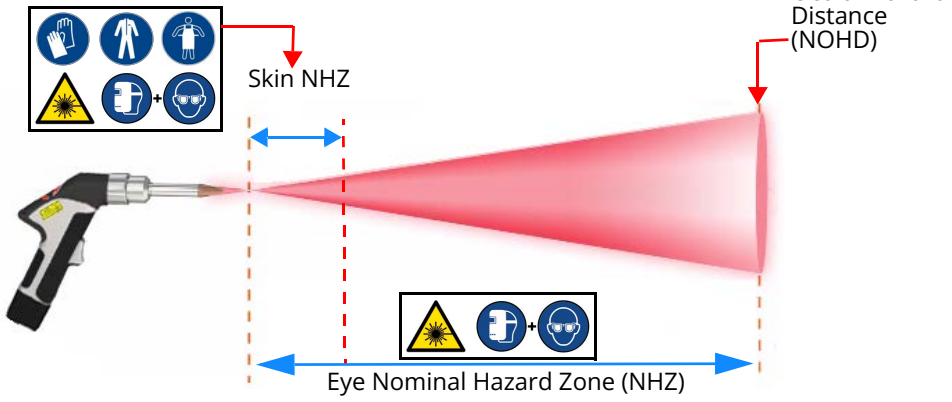
In the EU: Refer to Directive 2006/25/EC and TROS Laser Radiation.

▼ Table 8. Laser Safety Terms and Definitions

Laser Safety Terms	Definitions for Laser Safety Terms																											
Maximum Permissible Exposure (MPE)	The MPE is the irradiance or radiant exposure that can be incident upon the eye (or the skin) without causing injury or adverse biological changes in the eye or skin. MPE is the highest power (in W/cm²) or highest energy density (in J/cm²) of a light source that is considered to be safe. The MPE varies by wavelength of the laser, the energy involved, and the duration of exposure. MPE is a necessary parameter in determining the appropriate optical density (OD) and Nominal Hazard Zone (NHZ). Note there is a separate MPE value for eyes and for skin. In the EU: Reference Directive 2006/25/EC and TROS Laser Radiation.																											
Nominal Hazard Zone (NHZ)	The NHZ describes the space within which the level of direct, reflected or scattered radiation during operation exceeds the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the applicable MPE. If you are within the NHZ you are at risk of an exposure above the MPE and must be wearing PPE.																											
Nominal Ocular Hazard Distance (NOHD)	The NOHD, sometimes referred to as the Nominal Hazard Distance, is the distance along the axis of the unobstructed beam from a laser to the human eye, beyond which the irradiance or radiant exposure during normal operation is not expected to exceed the MPE. At distances greater than the NOHD the intensity from the laser beam is not hazardous for unaided viewing or exposure. The NOHD calculation depends on the beam characteristics of the laser such as the output power, beam diameter and beam divergence. The NOHD is usually much greater than the largest dimension of your work area.																											
Optical Density (OD)	The OD is a measure of the attenuation of laser radiation through a filter material. This value is primarily used in specifications for laser eyewear and viewing windows. The OD is used to determine the appropriate laser eye protection. The higher the OD, the greater the attenuation of the laser radiation. Calculated in base 10, OD is the logarithmic reciprocal of transmittance. As the OD increases, the protection against laser radiation increases by a factor of ten. $OD = \log_{10}\left(\frac{1}{T}\right)$ $T = 10^{-OD}$ where, T = Transmission (in decimal) <table><tr><th>OD</th><th>Transmission (in %)</th><th>Attenuation Factor</th></tr><tr><td>0</td><td>100%</td><td>1</td></tr><tr><td>1</td><td>10%</td><td>10</td></tr><tr><td>2</td><td>1%</td><td>100</td></tr><tr><td>3</td><td>0.1%</td><td>1,000</td></tr><tr><td>4</td><td>0.01%</td><td>10,000</td></tr><tr><td>5</td><td>0.001%</td><td>100,000</td></tr><tr><td>6</td><td>0.0001%</td><td>1,000,000</td></tr><tr><td>7</td><td>0.00001%</td><td>10,000,000</td></tr></table>	OD	Transmission (in %)	Attenuation Factor	0	100%	1	1	10%	10	2	1%	100	3	0.1%	1,000	4	0.01%	10,000	5	0.001%	100,000	6	0.0001%	1,000,000	7	0.00001%	10,000,000
OD	Transmission (in %)	Attenuation Factor																										
0	100%	1																										
1	10%	10																										
2	1%	100																										
3	0.1%	1,000																										
4	0.01%	10,000																										
5	0.001%	100,000																										
6	0.0001%	1,000,000																										
7	0.00001%	10,000,000																										

Laser safety hazard calculated values are specified in the table below.

▼ Table 9. Laser Safety Hazard Calculations

OptX 2kW Laser Safety Hazard Calculations		
		
EYE HAZARD CALCULATIONS		
	CW Laser Mode	HPP Laser Mode
NOHD:	230 meters (755 feet)	134 meters (440 feet)
MPE Irradiance:	0.005 W/cm ²	0.025 W/cm ²
MPE Radiant:	0.05 J/cm ²	0.000125 J/cm ²
SKIN HAZARD CALCULATIONS		
	CW Laser Mode	HPP Laser Mode
NHZ	16 meters (53 feet)	10 meters (33 feet)
MPE Irradiance:	1 W/cm ²	5 W/cm ²
MPE Radiant:	10 J/cm ²	0.025 J/cm ²

2.2.7 Device Safety Label Locations

The safety label banner which is affixed on the device, provides information on the laser radiation hazards that are present in your particular device.

The Miller safety label and the information listed on the safety label will vary based on the output power(s), wavelength(s), and other performance characteristics. It is important to review the labels affixed to the product for specific information about your laser device.

This product has the required safety labels located on the outside of the device enclosure at various locations. These include warning labels indicating removable or displaceable protective housings, apertures through which laser radiation is emitted and labels of certification and identification.

Refer to Table 10 [▶36] for a description of all safety labels and their placement on the product.

▼ Figure 1. Laser Safety Banner Label - Primary Laser



▼ Figure 2. Laser Safety Banner Label - Guide Laser



▼ Table 10. Safety Label Description and Location

1. Identification Plate Label	
	SERIAL NUMBER: NE120429L VOLTAGE: 208-240 VAC PHASE: SINGLE FREQUENCY: 50/60 Hz FULL LOAD CURRENT: 32 A MAXIMUM BREAKER SIZE: 40 A DESCRIPTION: LASER WELDER OptX 2kW LOT NUMBER: OX2R32403012U MANUFACTURE DATE: MARCH 2024 C.O.O.: USA
Rear panel of the device. (Products Made in the US) - See Figure 3 [▶ 39].	
2. Laser Radiation Hazard Label	3. Aperture Label (Laser Torch)
 Located near output aperture or exit point from the enclosure: (1) rear panel of the device, (2) top and sides of torch, (3) base of fiber cable output connector. See Figure 3 [▶ 39] and Figure [▶ 39].	 Located near output aperture on top of the handheld torch. See Figure 3 [▶ 39].
4. Primary Laser - Laser Class Label (Device)	5. Guide Laser - Laser Class Label (Device)
 Identifies the laser classification for the primary fiber laser used for material processing. It warns the operator of a laser radiation hazard. The operator must avoid exposure of the eyes or skin to direct or scattered radiation. Located on the rear and side of the unit. This label is specified in English, French and Spanish. See Figure 3 [▶ 39].	 Identifies the laser classification for the guide laser used for positioning torch nozzle on part. It cautions the operator to avoid eye exposure. Located on rear panel of the device. This label is specified in English, French and Spanish. See Figure 3 [▶ 39].

▼ Table 10. Safety Label Description and Location (Continued)

6. Primary Laser - Class 4 Information Label

MAX. AVERAGE OUTPUT POWER: 2500W MAX. PEAK OUTPUT POWER: 5000W PULSE DURATION: ≥ 1 μ s PULSE REPETITION RATE: 0 – 100kHz WAVELENGTH RANGE: 900 – 1200nm	PUISSANCE MAX. DE SORTIE MOYENNE : 2 500 W PUISSANCE MAX. DE SORTIE DE CRÊTE : 5 000 W DURÉE D'IMPULSION : ≥ 1 μ s TAUX DE RÉPÉTITION DES IMPULSIONS : 0 – 100 kHz GAMME DE LONGUEURS D'ONDES : 900 – 1 200 nm	POTENCIA DE SALIDA PROMEDIO MÁXIMA: 2500 W POTENCIA DE SALIDA PICO MÁXIMA: 5000 W DURACIÓN DE LOS PULSOS: ≥ 1 μ s TASA DE REPETICIÓN DE LOS PULSOS: 0 – 100 kHz RANGO DE LONGITUD DE ONDA: 900 – 1200 nm
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Identifies the output power, peak power, pulse duration, pulse repetition rate and wavelength range for the primary fiber laser used for material processing. Located on rear panel of the device. This label is specified in English, French and Spanish. See Figure 3 [► 39].

7. Red Guide Laser - Class 2M Information and Warning Label

LASER RADIATION DO NOT STARE INTO THE BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS CLASS 2M LASER PRODUCT MAX. AVERAGE POWER: 1mW WAVELENGTH RANGE: 600 - 700nm IEC 60825-1:2014	RAYONNEMENT LASER NE PAS REGARDER DROIT DANS LE FAISCEAU OU L'OBSERVER À L'AIDE D'INSTRUMENTS OPTIQUES PRODUIT LASER DE CLASSE 2M PUISSANCE MAX. MOYENNE : 1 mW GAMME DE LONGUEURS D'ONDES : 600 - 700 nm CEI 60825-1:2014	RADIACIÓN LÁSER NO MIRE HACIA EL HAZ NI VISUALICE EL HAZ DIRECTAMENTE CON INSTRUMENTOS ÓPTICOS PRODUCTO LÁSER CLASE 2M POTENCIA PROMEDIO MÁXIMA: 1 mW RANGO DE LONGITUD DE ONDA: 600 - 700 nm IEC 60825-1:2014
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Combination label for the guide laser that is used to position the torch nozzle on the part. This label identifies the output power and wavelength range. It also specifies the classification and warning. Located on rear panel of the device. This label is specified in English, French and Spanish. See Figure 3 [► 39].

8. FDA Certification Label

COMPLIES WITH FDA PERFORMANCE STANDARDS FOR LASER PRODUCTS EXCEPT FOR CONFORMANCE WITH IEC 60825-1 Ed. 3., AS DESCRIBED IN LASER NOTICE No. 56, DATED May 8, 2019	CONFORME AUX NORMES DE PERFORMANCE DE LA FDA POUR LES PRODUITS LASER, À L'EXCEPTION DE LA CONFORMITÉ À LA NORME CEI 60825-1 Éd. 3., TEL QUE DÉCRIT DANS L'AVIS RELATIF AU LASER N° 56, DATÉ DU 8 MAI 2019	CUMPLE LAS NORMAS DE DESEMPEÑO DE LA FDA PARA LOS PRODUCTOS CON LÁSER, EXCEPTO IEC 60825-1 Ed. 3., SEGÚN SE DESCRIBE EN EL AVISO PARA PRODUCTOS CON LÁSER No. 56, FECHADO 8 de mayo de 2019
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Located on rear panel of the device. This label is applicable for both the primary and guide laser. This label is specified in English, French and Spanish. See Figure 3 [► 39].

9. When Panel Open Label

DANGER – CLASS 4 VISIBLE AND INVISIBLE. LASER RADIATION WHEN OPEN. AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION. IEC 60825-1:2014	DANGER – PRÉSENCE D'UN RAYONNEMENT LASER DE CLASSE 4 LORSQUE L'UNITÉ EST OUVERTE. ÉVITER TOUTE EXPOSITION DES YEUX OU DE LA PEAU AUX RAYONS DIRECTS OU DIFFUSÉS. ÉNERGIE LASER – TOUTE EXPOSITION À PROXIMITÉ DE L'OUVERTURE PEUT PROVOQUER DES BRÛLURES. IEC 60825-1:2014	PELIGRO: RADIACIÓN LÁSER CLASE 4 CUANDO ESTÁ ABIERTO. EVITE LA EXPOSICIÓN DE LOS OJOS O DE LA PIEL A LA RADIACIÓN DIRECTA O DISPERSA. ENERGÍA LÁSER: LA EXPOSICIÓN CERCA DE LA ABERTURA PUEDE PROVOCAR QUEMADURAS. IEC 60825-1:2014
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Located on device side panels near bottom. This label is specified in English, French and Spanish. See Figure 3 [► 39].

10. Laser Class Label (Laser Torch)



Located near output aperture: Left and right side of the laser torch boot. See Figure 3 [► 39].

▼ Table 10. Safety Label Description and Location (Continued)

11. Protective Conductor Terminal	12. Safety Label - QR Code ¹	13. Patent List Label																
 This symbol is specifically reserved for the PROTECTIVE CONDUCTOR TERMINAL and no other. This is placed at the device earthing point and is mandatory for all grounded equipment. Located on rear panel below AC power switch. See Figure 3 [▶ 39].	SCAN THIS CODE OR VISIT MillerWelds.com/optinfo TO VIEW IMPORTANT SAFETY INFORMATION AND THE USER GUIDE.  920-954-3610 Scan QR code to access online product safety content, Owner's Manual, etc. Label also specifies the support phone number. Label is located on top right corner of front panel. See Figure 3 [▶ 39].	This device is covered by US patents: <table><tr><td>7,893,901</td><td>8,068,705</td></tr><tr><td>8,724,945</td><td>8,160,415</td></tr><tr><td>9,213,135</td><td>8,948,218</td></tr><tr><td>10,615,570</td><td>9,647,410</td></tr><tr><td>11,621,540</td><td></td></tr></table> and other US & International patents pending <table><tr><td>WO2022/266530</td><td>US20210305765</td></tr><tr><td>WO2022/266534</td><td>29/756,161</td></tr><tr><td>WO2022/046869</td><td></td></tr></table> CMUS0009286XXXU Rev C List of patents that are applicable to this device. Label is located next to the identification label on the rear panel. See Figure 3 [▶ 39].	7,893,901	8,068,705	8,724,945	8,160,415	9,213,135	8,948,218	10,615,570	9,647,410	11,621,540		WO2022/266530	US20210305765	WO2022/266534	29/756,161	WO2022/046869	
7,893,901	8,068,705																	
8,724,945	8,160,415																	
9,213,135	8,948,218																	
10,615,570	9,647,410																	
11,621,540																		
WO2022/266530	US20210305765																	
WO2022/266534	29/756,161																	
WO2022/046869																		
14. Welding Safety Label																		
 ⚠ WARNING Do Not Remove, Destroy, Or Cover This Label.  WELDING can be hazardous. - Read and follow all labels and the Owner's Manual carefully. - Only qualified persons are to install, operate, or service this unit according to all applicable codes and safety practices. - Keep children away.  ELECTRIC SHOCK can kill. - Always wear dry insulating gloves. - Insulate yourself from work and ground. - Do not touch live electrical parts. - Disconnect input power before servicing. - Keep all panels and covers securely in place.  FUMES AND GASES can be hazardous. - Keep your head out of the fumes. - Ventilate area, or use breathing device. - Read Safety Data Sheets (SDSs) and manufacturer's instructions for materials used.  WELDING can cause fire or explosion. - Do not weld near flammable material. - Watch for fire; keep extinguisher nearby. - Do not locate unit over combustible surfaces. - Do not weld on closed containers. Read ANSI Z136.1 "Safe Use of Lasers," at www.ansi.org; ANSI Standard Z49.1, "Safety in Welding, Cutting, and Allied Processes," at www.aws.org; OSHA Safety and Health Standards, 29 CFR 1910, at www.osha.gov.	 ⚠ AVERTISSEMENT Ne pas enlever, détruire ou masquer cette étiquette. Le SOUDAGE peut être dangereux. - Lire et observer avec attention les consignes figurant sur toutes les étiquettes et dans le manuel de l'utilisateur. - Seules les personnes compétentes devraient installer, faire fonctionner ou assurer l'entretien de cet appareil conformément à tous les codes et pratiques de sécurité en vigueur. - Garder les enfants à distance. UN CHOC ÉLECTRIQUE peut tuer. - Porter toujours des gants isolants secs. - S'isoler de la pièce et du sol. - Ne jamais toucher les pièces électriques sous tension. - Couper l'alimentation avant de faire l'entretien de l'appareil. - Maintenir fermés et fixement en place les panneaux et les recouvrements. LES VAPEURS ET LES FUMÉES peuvent être nocives. - Éloigner votre tête des endroits renfermant des vapeurs. - Aérer la zone de travail ou porter un appareil respiratoire. - Consulter les fiches signalétiques (FS) et les consignes d'utilisation du fabricant pour les matériaux utilisés. LE SOUDAGE peut causer un incendie ou une explosion. - Ne pas souder à proximité de matières inflammables. - Prendre garde aux incendies et toujours avoir un extincteur à proximité. - Ne pas placer l'appareil au-dessus d'une surface combustible. - Ne pas souder les récipients fermés. Consultez la norme ANSI Z136.1, intitulée « Safe Use of Lasers », sur www.ansi.org; ANSI Z49.1, intitulée « Safety in Welding, Cutting, and Allied Processes », sur www.aws.org; OSHA Safety and Health Standards, 29 CFR 1910, sur www.osha.gov.	 ⚠ ADVERTENCIA No quite, destruya o tape esta etiqueta. LA SOLDADURA puede ser peligrosa. - Lea y siga con cuidado todas las etiquetas y el manual del operador. - Solamente personas calificadas deben instalar, operar, o reparar esta máquina según códigos y prácticas de seguridad. - Mantenga a los niños alejados. UNA DESCARGA ELÉCTRICA puede matarlo. - Siempre use guantes secos que le aislen. - Aíslese del trabajo y la tierra. - No toque piezas que estén eléctricamente vivas. - Desconecte la potencia de entrada antes de dar servicio. - Mantenga todos los paneles y cubiertas en su sitio. HUMO y GASES pueden ser peligrosos. - Mantenga su cabeza fuera del humo y los gases. - Ventile el lugar o use un aparato para respirar. - Lea las Hojas de datos del material (SDS) que utiliza y las instrucciones del fabricante. EL SOLDAR puede causar fuego o explosión. - No suelde cerca de materiales inflamables. - Siempre mire que no haya fuego; mantenga un extinguidor de fuego cerca. - No lo localice sobre superficies combustibles. - No suelde en recipientes cerrados. Lea la norma ANSI Z136.1, "Safe Use of Lasers," en www.ansi.org; ANSI Z49.1, "Safety in Welding, Cutting, and Allied Processes," en www.aws.org; OSHA Safety and Health Standards, 29 CFR 1910, en www.osha.gov. 295965-A																
Warning label that specifies welding related hazards. It is located on the top of the device. This label is specified in English, French and Spanish. See Figure 3 [▶ 39].																		
15. Compliance Label ¹																		
CAN ICES-003 (A) / NMB-003 (A) This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. The presence of this label indicates compliance to part 15 of the FCC rules (US) and CAN ICES-003 (A)/NMB-2 (A) (Canada). See Figure 3 [▶ 39].																		

¹ Consult the Owner's Manual for information concerning the warning symbols and statements that are marked on the equipment.

▼ Figure 3. Label Placement — Device Panels and Torch



Item	Designation	Item	Designation	Item	Designation
1	Identification Plate Label	2	Laser Radiation Hazard Label	3	Aperture Label (Laser Torch)
4	Primary Laser ¹ - Laser Class Label (Device)	5	Guide Laser ² - Laser Class Label (Device)	6	Primary Laser - Class 4 Information Label
7	Red Guide Laser - Class 2M Information and Warning Label	8	FDA Certification Label	9	When Panel Open Label
10	Laser Class Label (Laser Torch)	11	Protective Conductor Terminal	12	Safety Label - QR Code
13	Patent List Label	14	Welding Safety Label	15	Compliance Label

1. The primary laser is the main fiber laser in the device and is used for material processing during welding (or cleaning) operation. The IR laser output is invisible.
2. The visible output from the red guide laser is used by the Operator of the device to position the torch nozzle onto the part being processed prior to starting the laser welding (or cleaning) operation.

WARNING

Risk of injury due to illegible or missing labels

Over time labels can become dirty and illegible due to wear, tear or fading. If labels are illegible, hazards cannot be recognized and necessary operational instructions cannot be determined or followed, resulting in potential injuries to personnel and damage to equipment.

- Always keep the labels in good condition so they remain legible.
- Never remove any of the labeling affixed onto the product.
- If any label is damaged, illegible or missing, contact Miller Service (refer to section B.1 [▶169]) for replacement.

2.3 Regulatory Compliance

The **OptX** product is designed and engineered with important safety features and performance and complies with applicable standards and specifications in accordance with governmental requirement.

▼ Table 11. Compliance Standards Listing

Standard	Title / Description
Directives:	
2014/35/EU	The Low Voltage Directive covers all electrical equipment and components designed for use with a voltage rating of between 50 and 1000 V for alternating current (AC) and between 75 and 1500 V for direct current (DC). It provides the essential (safety) requirements that electrical equipment and components covered by it must comply with, and it outlines the conformity assessment procedure the manufacturer must apply in order to ensure compliance with the essential requirements.
2014/30/EU ¹	The EMC Directive aims to ensure that any electrical and electronic equipment minimizes the emission of electromagnetic interference that can influence other equipment. The directive also requires equipment to be able to resist the disturbance of other equipment.
Electromagnetic Compatibility (Emissions and Immunity): ¹	
IEC 61326-1 (EU)	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General Requirements
IEC 61000-6-2 (EU)	Electromagnetic Compatibility (EMC) - Part 6-2: Generic Standards - Immunity Standard for Industrial Environments
IEC 61000-6-4 (EU)	Electromagnetic Compatibility (EMC) - Part 6-4: Generic Standards - Emission Standard for Industrial Environments
Class A (Digital Device): ¹	
47CFR15 Sub-Part B FCC (US)	Code of Federal Regulations (CFR) - Title 47. Telecommunication - Chapter 1. Federal Communication Commission - Subchapter A. General - Part 15. Radio Frequency Devices
ICES-003 (Canada)	Information Technology Equipment (ITE), including digital apparatus - Limits and Methods of Measurement

▼ Table 11. Compliance Standards Listing (Continued)

Standard	Title / Description
Electrical Safety:	
EN/ISO 61010-1 (EU)	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
Laser Safety:	
IEC 60825-1 (EU)	Safety of Laser Products - Part 1: Equipment Classification and Requirements
CDRH 21 CFR 1040.10 (US)	Code of Federal Regulations (CFR) - Title 21. Food and Drugs - Chapter I. Food and Drug Administration - Department of Health and Human Services - Subchapter J. Radiological Health - Part 1040. Performance Standards for Light-Emitting Products - Section 1040.10. Laser Products
Worker and Workplace Safety Regulations:	
29 CFR (US)	Code of Federal Regulations (CFR) - Title 29. Labor. Subtitle B - Regulations Relating to Labor - Chapter XVII - Occupational Safety and Health Administration (OSHA), Department of Labor
OSHA	Occupational Safety and Health Standards for Food and Drugs, Title 21 Code of Federal Regulations (CFR) Chapter I, Subchapter J, 1040.10 Laser products.
OSHA	Technical Manual (OTM), Section III: Chapter 6, Laser Hazards

¹. when marked as such on the product

2.3.1 Class A Digital Device

This equipment is tested and complies with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules and Canadian ICES-003 when marked as such on the product. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Modifications of this product could result in non-compliance with FCC rules. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this manual, can cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the users are required to correct the interference at their own expense.

2.3.2 Electromagnetic Compatibility

Compliance with the EMC requirements is certified by the CE mark when marked as such on the product. The European requirements for Electromagnetic Compliance are specified in the "EMC Directive." Conformance to the "EMC Directive" is achieved through compliance with the harmonized standards.

2.4 Important Operation Safety Information

2.4.1 Secondary Radiation Hazard

WARNING



Visible and invisible light radiation produced during device operation

The interaction between high power laser beams and target materials being welded can create plasmas that produce UV emissions and “blue light” which can cause conjunctivitis, photochemical damage to the retina and/or sunburn-like reaction to the skin.

Welders who are exposed to invisible UV light without proper protection can suffer permanent eye damage. Even brief exposure to invisible UV light during welding can cause blurred vision, burning, tearing, eye pain and irritation (feeling of sand in your eye).

2.4.2 Protective Eyewear for Laser Welding and Cleaning

For laser welding, it is not sufficient to wear PPE that only protects against the laser’s IR wavelength. The selection of PPE should also take into account the secondary radiation hazards discussed in section 2.4.1 [\[▶ 42\]](#) as well.

DANGER



Eye hazards during OptX device operation

Risk of permanent eye damage and vision impairment from invisible reflected and scattered Class 4 laser radiation. Also risk of eye damage as a result of exposure to UV light, welding bright light, heat and sparks produced during the material processing.

- All persons in the Laser Controlled Area must wear the combination of (1) the specified laser safety eyewear, and (2) laser welding helmet with appropriate filters (for UV and visible radiation) will offer the best protection during laser welding.
- A laser welding helmet can also protect the Operator from being injured due to hot spatter, metal particulates and sparks.

2.4.3 Skin Hazard

WARNING



Welding and cleaning process - UV radiation

Damage to skin from exposure to UV-radiation produced during the welding (or cleaning) process.

- PPE must be worn during equipment operation.
- Required PPE includes: (1) welding helmet over specified laser safety eyewear, (2) heat-resistant gloves, (3) heat-resistant clothing, and (4) heat-resistant apron. Sleeves and collars should be buttoned.

WARNING



Welding process - High temperature

Severe skin burn from contact to hot surface or exposure to thermal radiation or hot particles.

- PPE must be worn during welding.
- Required PPE includes: (1) welding helmet over specified laser safety eyewear, (2) heat-resistant gloves, (3) heat-resistant clothing, and (4) heat-resistant apron. Sleeves and collars should be buttoned.
- Avoid touching the welded part or the torch nozzle tip and/or tube, with unprotected skin, immediately and shortly after laser emission.

Exposure to UV light can cause skin burns that are similar sunburns and will increase a welder's risk of skin cancer and accelerated signs of skin aging.

Depending on the intensity of the IR light, skin injuries can include thermal burns or excessive dry skin.

Welding sparks can also cause burns.

Laser material processing can transfer a significant amount of energy into a part. Parts can be hot even after the welding (or cleaning) process is complete. Parts of the torch can become hot during use. Ensure that the proper PPE is used to protect against potential burns.

Take precautions to prevent skin damage by wearing protective clothing such as heat-resistant gloves, caps, leather apron and other heat-resistant clothing. Protective clothing must be sufficiently resistant to UV radiation. Sleeves and collars should be buttoned.

2.4.4 Fire Hazard

DANGER



Laser can ignite solvents, gases, combustible materials

Laser light can ignite volatile substances such as alcohol, gasoline, ether and other solvents and flammable gases (e.g. MAPP gas) causing a fire or explosion.

- Exposure to solvents and other flammable materials and gases must be avoided and considered when installing and using this device.
- Do not weld combustible and flammable materials (e.g. magnesium).
- Combustible and flammable materials should be completely removed from the laser area whenever possible.

DANGER



Laser welding and cleaning can generate a fire or explosion

The heat and sparks produced during system operation are capable of starting a fire or causing an explosion.

- Laser welding should only be performed if the area is free of combustible materials.
- Never weld on containers that have flammable or combustible material.
- If the container contents are unknown, you should assume they are flammable or combustible.
- Fire extinguishers should be nearby and accessible and personnel should be trained in their usage.

There are two types of fire extinguishers that should be available near the laser area.

1. **ABC Dry Chemical** fire extinguisher is a good general purpose fire extinguisher to have available. This type of fire extinguisher is suitable for:
 - a. Fires involving solid materials, usually of an organic nature whose combustion results in the formation of embers, such as wood, paper and textiles.
 - b. Fires due to flammable liquids.
 - c. Electrical Fires
2. **Class D Dry Powder** fire extinguisher must also be available. This type of fire extinguisher is suitable for combustible metal fires.

DANGER



Using incorrect fire extinguisher can accelerate metal fire

A water or CO2 extinguisher WILL NOT extinguish a metal fire. Choosing the right extinguisher can lessen or prevent property damage and save lives.

- Class D (Dry Powder) fire extinguisher must be used for combustible metal fires.
- The most common types of Class D fires occur in environments where fine metal powders, flakes, shavings, chips or similarly sized products are generated (such as aluminum powder and iron shavings).
- Ensure the Laser Controlled Area is kept tidy.
- To determine which extinguishing medium is most appropriate to use, a specialist should be consulted. Specific studies are required for Class D type fires and extinguishing medium.
- **In the EU:** Refer to regulations such as EN 2, EN3, and EN 1866.

2.4.5 Reflected Beam Hazard During Welding

WARNING



- Avoid / minimize specular reflections. This primary laser in this product emits invisible laser radiation, corresponding to laser Class 4, at or around a wavelength of 1070nm (infrared).
- In addition, the guide laser in this product emits visible laser radiation, corresponding to laser Class 2M, at or around a wavelength of 600-700 nm (red).

Often there can be numerous secondary laser beams produced at various angles near the laser output aperture. These beams are called “Specular Reflections” and are produced when the laser light reflects off a surface where the primary beam is incident.

Laser welding systems can create specular reflections due to the interaction of the laser beam and the parts being processed. Although these secondary beams can be less powerful than the total power emitted from the laser, the intensity can be great enough to cause damage to the eyes and skin as well as materials surrounding the laser.

WARNING



- **Highly reflective metals such as aluminum and copper can cause some portion of the beam energy to be reflected from the target weld site and require additional precautions.**
- **Specular reflections can also present a hazard to the operator and observers if any portion of the beam is reflected from multiple surfaces.**
- **Take precautions to understand the expected cone of specular reflection for each processed part and do not attempt to view the part or place any part of the body within the expected specular reflection cone. See Figure 4 [▶ 47].**

WARNING



Operators and observers must also be aware of reflections at all times. More reflections are likely to occur if laser parameters are not set correctly to achieve melting of the target part.

IMPORTANT

The following guidelines apply to all models. To achieve Safe Operating Conditions:

1. Proper Mode Selection Based on Material and Thickness.
2. Proper Nozzle Selection Based on Joint Geometry - See Table 12 [▶ 46].

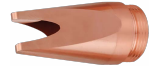
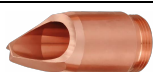
For safety reasons, Miller requires that **OptX** device operators only use Miller nozzle tips. The part number for the Miller Nozzle Tip Kit is specified in the Accessories Table 15 [▶ 61]. Replacement nozzle tips are available for purchase.

3. Proper nozzle installation - See sections 7.3.2 [▶ 109] and 7.3.3 [▶ 109].
4. Proper angle and position of the torch - See Figure 4 [▶ 47].

When operating the system in CLEAN laser mode, there are 3 additional nozzles available. Refer to Table 12 [▶ 46].

- Compared to other models, the cleaning nozzles are sized differently due to optical differences within the torch. Therefore, users with multiple model types should not mix and match the cleaning nozzles. **OptX** models must use the **OptX** cleaning nozzles.

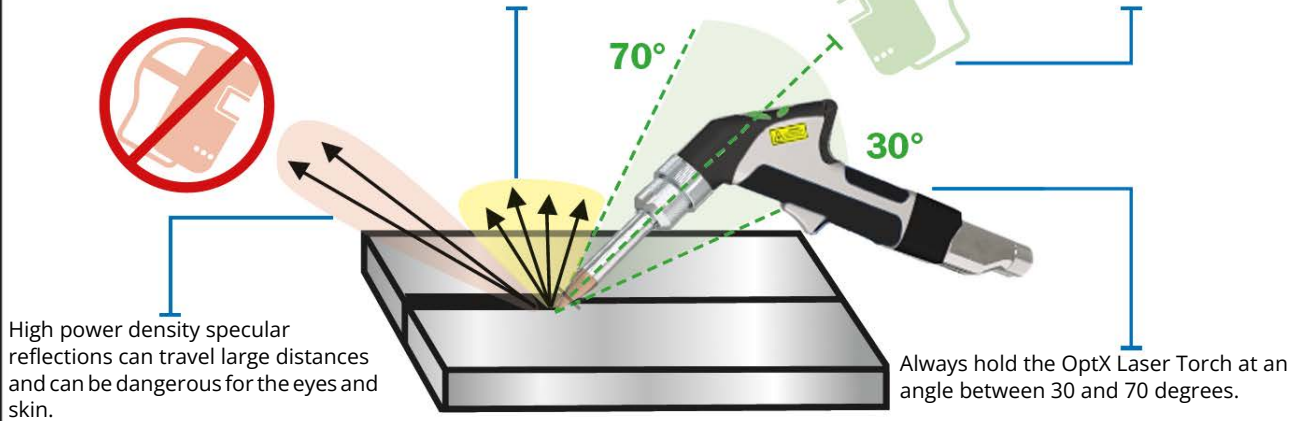
▼ Table 12. Welding and Cleaning Nozzle Selection Chart

WELDING AND CLEANING NOZZLE SELECTION					
	Butt Joint	Corner Joint	Tee Joint	Lap Joint	Edge Joint
					
Welding					
					
Cleaning					
WELDING NOZZLE KIT (#301832)			CLEANING NOZZLE KIT (#301833)		
Nozzle, OptX, Welding, Conical #301811			Nozzle, OptX, Cleaning, Outside Corner #301819		
Nozzle, OptX, Welding, 1-Point #301812			Nozzle, OptX, Cleaning, 1-Point #301820		
Nozzle, OptX, Welding, 2-Point 6mm #301813			Nozzle, OptX, Cleaning, 2-Point #301821		
Nozzle, OptX, Welding, 2-Point 9mm #301814					
Nozzle, OptX, Welding, Wire Feed #301815					

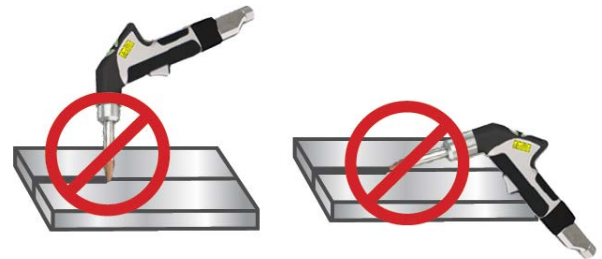
▼ Figure 4. Torch Angle, Reflections and Viewing Position

Lower power density radiation scattered from the process zone can travel certain distances. Within the Ocular Hazard Distance, the scattered radiation can be dangerous to the eyes. At very short distances the scattered radiation can also be dangerous for the skin.

Always maintain viewing position at least 20 inches (500 mm) from the weld seam and behind reflection zones.



Laser Beams can reflect from multiple surfaces. Always be aware of the potential for multiple reflections during welding.



Improper Torch Positioning Angle

2.4.6 Process By-Products and Fume Hazards

When a laser beam reacts with any material, it can generate vapors, fumes, sparks and particulate debris. By-products from the laser process are often toxic and can pose additional safety hazards.

WARNING



Welding process fumes and particles

Damage to body tissues or organs from exposure to fumes and other by-products produced by the welding process.

- Measures must be taken by the user depending on the material of the work-piece.
 - During welding keep your head away from the fumes.
 - Always weld in an area with adequate ventilation.
 - Hazardous and toxic fumes, vapors and particles need to be captured and exhausted from the work area by means of an extraction system.
 - Ensure that the work surface is properly vented. The opening of the capturing unit has to be placed as close as possible to the process zone.
 - PPE (respiratory protection) must be worn if released hazardous substances cannot be extracted close to the process.
-
- Welding fumes can be comprised of very fine particles and gases. Welding fumes and gases come from a combination of the material being welded or any filler material used, shielding gases used, paints, coatings, chemical reactions, and air contaminants.
 - **Welding fumes can adversely affect the lungs, heart, kidneys and central nervous system. Primarily, the released hazardous substances are absorbed via the respiratory organs (i.e. inhaled).**
 - When the laser interacts with target materials such as plastics, metals, composites, the target material can start to vaporize. **Often the fumes and mists cannot be seen, but are very toxic and pose a serious health hazard.**
 - UV emissions given off during the welding process can react with the oxygen and nitrogen in the air to form ozone and nitrogen oxides which at high concentrations can be deadly.

WARNING



Risk of asphyxiation in poorly ventilated confined spaces

Shielding gases used during welding can displace the air. Dangerous concentrations of toxic fumes and gases can build up very quickly causing unconsciousness and death from suffocation.

- Conduct routine air monitoring to determine the levels of hazardous fumes in the laser area.
- In confined spaces and other circumstances, the use of a respirator can also be required.

NOTICE**Risk assessment for welding fumes, particles, and dust**

It is the responsibility of the system owner to ensure proper disposal of waste debris and other by-products. Any extraction system must comply with local and health and safety regulations. System owner minimum requirement before starting the laser process is to:

- be familiar with the material to be processed, know what by-products can result, assess their risk to health and determine what precautions are necessary;
- read and obey the safety data sheets and warning labels for all welding materials used;
- employ appropriate measures to prevent or control the risk, such measures will normally require positive exhaust of fumes from the process zone and adequate purification before exhaust gases are returned to the atmosphere away from personnel;
- inform, instruct and train operators about the risks, and the precautions to be taken;
- where necessary, monitor the exposure of operators and carry out an appropriate form of surveillance of their health in compliance with local regulations;
- consult a pertinent authority to find out what national, state and/or local regulations must be satisfied before exhaust gases are returned to the atmosphere.

In Germany: observe and refer to the requirements in the following regulations:

- Technical Rules for Hazardous Substances TRGS 560 "Air recirculation for activities involving carcinogenic, mutagenic and fertility-endangering dust".
- Technical Rules for Hazardous Substances (TRGS), in particular TRGS 402, TRGS 900 and TRGS 910, as well as TRGS 528 for welding work (all freely available on the Internet from the Federal Institute for Occupational Safety and Health - BAuA).
- Ordinance on Hazardous Substances (GefStoffV).
- Ordinance on Preventative Occupational Health Care (ArbMedVV).

2.4.7 Gas Cylinder Safety

WARNING**Placement and securing of gas cylinders**

Gas cylinders may explode if damaged or placed nearby to the welding area causing injury and property damage. Injury is also possible if cylinder tips over.

- Gas cylinders should be shielded and located in areas where they cannot be struck or damaged.
- Place them away from sources of heat, sparks or flame, as well as deflection from laser beam.
- Cylinder must be stored upright and secured to a fixed support.

Need to have working regulators that are suitable for the gas and pressure required. All hoses and fittings should also be suitable for the application and maintained in good working condition.

2.5 General Safety Instructions

NOTICE

If this laser device is used in a manner not specified in this document, the protection provided by the device can be impaired and the warranty will be voided.

WARNING



Do not use torches from other suppliers

Connecting fiber or electrical connector to the torch from other suppliers will cause safety functions to not work as intended. This can also damage the equipment and increase the risk of injuries due to laser irradiation.

- Only connect the fiber to an Miller approved and supplied torch.
- Do not plug in other devices to the laser welder head connections on the rear panel other than the cable and head provided.

2.5.1 Establish a Laser Controlled Area

WARNING



Laser controlled area required for class 4 laser product operation

For more information on setting up a laser controlled area, the site Laser Safety Officer or safety officer should refer to the most recent revision of:

- **In EU:** IEC 60825-4 Safety of Laser Products - Part 4: Laser Guards
- **In US:** American National Standards Institute publication ANSI Z136.1 and Z136.7.

Personnel Qualifications: Laser Safety Officer and Maintenance Personnel (see section 1.4 [▶18]).

- In many jurisdictions, laser safety regulations require the appointment of a site Laser Safety Officer (LSO). The employer is primarily responsible for conformance and enforcement of laser safety regulations but can delegate the responsibilities or tasks. Key points for setting up the Laser Controlled Area is the determination of the foreseeable maximum irradiation personnel can be exposed to, then design of the PPE and shielding of the laser area.
- The primary laser in this product is Class 4. Therefore, the appointment of a site LSO is mandatory:
 - In Germany:** According to OStrV, the appointment of a site LSO is mandatory when workers use or are exposed to Class 3R, 3B and 4 laser products.
 - In US:** According to ANSI Z136.1, the appointment of a site LSO is mandatory when workers use or are exposed to Class 3B and Class 4 laser products.
- Work with your site LSO to establish a laser controlled area (LCA) to protect all personnel working in the area from being directly or indirectly exposed to the laser beam.
- Ensure that all personal protective equipment (PPE) is suitable for the output power and wavelength range listed on the laser safety labels affixed to the product. Any PPE must also be suitable for any secondary radiation. Ensure that laser protective eyewear, clothing and shields are available and being used by personnel.
- Use the laser **only** in a laser controlled area with access controlled by door interlocks. Refer to Section 5.8 [▶84] for an example of how to configure door interlocks to the laser controlled area.

- Provide suitable barriers to secure a laser safe work area and to prevent the beam from escaping the area. Any barriers used in the LCA should be made of a laser-safe material that can withstand direct and diffusely scattered beams.

In EU: refer to EN 60825-4.

- Post warning signs outside the LCA when the laser is in use. Appropriate warning signs must be posted throughout the controlled area, especially at any entrances to and from the area. For example, a sign warning of potential eye hazard must be placed outside the entrance to the enclosed controlled area.

In EU, the marking of the laser area is mandatory according to EN 60825-1.

- Restrict access in the LCA to only those individuals who are trained in laser safety while operating the handheld laser device. Post a sign with the names of all persons authorized to work within the laser work area.

2.5.2 Optical Safety

NOTICE

Protective window inside torch

The laser output is delivered through a protective window. Any dust on the end of the torch assembly can burn the window and damage the laser.

- Make sure that the window is clean and of good quality. Refer to maintenance section A.1.1 [▶156].

⚠ DANGER



Class 4 laser radiation from aperture

Risk of permanent eye damage and vision impairment from invisible direct class 4 laser beam.

- **NEVER look directly into a laser aperture (such as the output fiber, or torch) while the unit is powered.**
- Avoid positioning the laser and all optical components at eye level.
- Avoid using the laser in a darkened environment.
- Provide enclosures for the laser beam.
- Always turn the key to the OFF position and disconnect AC power when working with the output (i.e. mounting the laser head into a fixture, etc.). As an added precaution, remove the key from the keyswitch during such work.
- **Wear the specified laser safety eyewear and a welding helmet with appropriate filters and face shield at all times while operating the product.**
- Ensure that all personal protective equipment (PPE) is suitable for the output power and wavelength range listed on the laser safety labels that are affixed to the product.

⚠ CAUTION



Do not install or terminate the laser head when laser is active

- Always ensure the key is in the OFF position and unit is disconnected from AC power when performing these tasks.

2.5.3 Equipment

Laser light is strong enough to burn skin, clothing, and paint. The laser can cut and weld metal.

Light-sensitive elements in equipment, such as video or still cameras can also be damaged from exposure to the laser light.

2.6 Electrical Safety

WARNING



Electrical Voltage

Lethal danger from direct or indirect contact with live parts.

- There are no operator serviceable parts inside. Refer all servicing to qualified Miller personnel.
- To prevent electrical shock, do not remove covers.
- Any tampering with the product voids the warranty.

WARNING



The input voltage to the laser weld unit is potentially 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 device housing should be considered dangerous.

IMPORTANT

- All electrical and weld gas connections must be connected prior to applying power to the unit.
- In addition and where applicable, all connections must be secured with screws to ensure proper functionality.

WARNING



Improper grounding and AC voltage

To Ensure Electrical Safety:

- Make sure the device is properly grounded through the protective conductor of the AC power cable. Any interruption of the protective grounding conductor from the protective earth terminal can result in personal injury.
- Before supplying the power to the device, ensure that the correct voltage of the AC power source is used. Failure to use the correct voltage can cause damage to the device. Refer to the markings on your specific model for proper electrical supply connection.
- Connections to external circuits except for Mains connections: the external connections between this product and other external devices are PELV (Protected Extra-Low Voltage) as defined by IEC 61140. Non-Mains outputs of other devices connected to this product should also be PELV or SELV (Safety Extra-Low Voltage).

2.7 Environmental Safety

The equipment is designed for:

1. Indoor Use (non-residential)
2. Operation at less than 2000 meters altitude
3. Over Voltage Category II
4. Pollution Degree 2 Environment
5. Dry Locations - Do not operate in the rain/water.

6. Ambient Air Temperature of 5-35°C
7. Relative Humidity of 10-90%.
8. Refer to product specifications for additional information.

This equipment is not suitable for use in locations where unprotected persons or children may be present. Keep away from sources of shock or vibration.

WARNING

- Ensure that all personal protective equipment (PPE) is suitable for the output power and wavelength range listed on the laser safety labels that are affixed to the laser.
- Inattentive or careless actions and operation can result in injuries to the operator due to reflected or scattered laser radiation.

NOTICE

- Inattentive, careless actions and operation can damage this laser equipment. Use caution while operating this equipment.
- Follow all safety, operating and maintenance instructions in this Owner's Manual.

Proper enclosures have to be used to secure a laser safe work area. This includes but is not limited to laser safety signs, interlocks, appropriate warning devices and training/safety procedures. Do not operate with the laser torch at eye level.

2.7.1 Emitted Noise Level During Use

The sound produced by this product **can exceed 80 db(A)** in some conditions of use. This level may be regarded as a hazard by some authorities. The sound pressure level should be measured in conditions of actual use. The use of protective earpieces and/or other sound mitigation means such as barriers or baffles may be required. Follow local requirements, codes and regulations.

For product installation within the European Union, reference standard EN ISO 11553-3.

2.7.2 Humidity

Do not expose the device to a high-moisture environment (>90% humidity).

2.7.3 Cooling and Temperature

The laser device is air-cooled. Operation at higher temperatures will accelerate aging, increase threshold current and lower slope efficiency. If the device is overheated, do not use it and call Miller Service for assistance. The device will turn emission off automatically and generate an alarm when the temperature of the laser exceeds 55°C.

2.7.4 Recycling and Disposal

NOTICE



WEEE directive for environmentally safe disposal

Incorrect disposal leads to environmental contamination and pollution.

- Electronic devices have to be disposed according to the regional directives on waste electrical and electronic equipment (WEEE) such as directive 2012/19/EU.
- Do not dispose of this product with unsorted municipal waste. At the end of life, this product must be sent to separate collections facilities for recovery and recycling.
- Contact your local recycling office or your local distributor (B.1 [▶ 169]) for further information concerning the decommissioning of this product.

By properly recycling electrical and electronic equipment, users can ensure environmentally sound treatment and disposal of waste equipment to reduce the potential for any environmental or health risks that can occur as a result of incorrect disposal.

2.8 Safety, Training, and Standards Resources

2.8.1 General Information

General information about laser products:

- For US installations, visit the FDA website:
 - <https://www.fda.gov/radiation-emitting-products/home-business-and-entertainment-products/laser-products-and-instruments>
- For installations within the EU, visit the following website:
 - https://www.baua.de/DE/Themen/Anwendungssichere-Chemikalien-und-Produkte/Produktsicherheit/Laserprodukte/Laserprodukte_node.html

General information about metal welding:

- For US installations, visit the American Welding Society at:
 - <https://www.aws.org>
- For installations within the EU, visit the following websites:
 - <https://www.safetyxperts.de/arbeitschutz/gefaehrdungsbeurteilung/gefahren-und-gefaehrdungen/schweissarbeiten/>
 - <https://www.bghm.de/arbeitsschueter/bibliothek/schweissen>
 - <https://aug.dguv.de/fuer-die-praxis/arbeitswelt/sicheres-schweissen-mit-der-richtigen-ausruestung/>

2.8.2 Laser Training Resources

For laser safety training, you may contact one of the following organizations listed in Table 13 [▶ 55].

▼ Table 13. Laser Training Resources

Item	Organization ¹
For European Union:	
1	LZH Laser Akademie https://www.lzh-laser-akademie.de/de/seminare/lasersicherheit/laserschutzbeauftragter-fuer-technische-anwendungen/
2	Bayerisches Laserzentrum (BLZ) https://www.blz.org/laserschutz/
3	Laservision https://www.uvex-laservision.de/laserschutzkurse/
4	TÜV Rheinland Akademie https://akademie.tuv.com/weiterbildungen/laserschutzbeauftragter-im-betrieblichen-alltag-488131
For United States:	
5	Laser Institute of America (LIA) https://lia.org/training
6	Laservision https://www.lasersafety.com/services/onsite-training/
7	Rockwell Laser Industries https://www.rli.com/Training/courses.aspx
8	Laser Safety Certification (LSC) https://www.lasersafetycertification.com/
9	Kentek Corporation https://www.kenteklaserstore.com/lightweld-class-4-laser-safety?utm_source=pd https://lasersafetyu.kentek.com/product/laser-safety-training-classroom/laser-safety-officer-online-course

¹. Miller provides this information solely for convenience. Miller does not endorse any organization, products or services, and assumes no liability for their products or services.

2.8.3 OptX Device Operation Training Resources

For information on using the **OptX** device in metal welding applications, users can access training videos on the Miller Secure Support Page:

www.millerwelds.com/optxinfo

Content can be accessed by entering the system serial number where prompted. This page currently includes 7 training videos:

1. Initial Setup and System Overview
2. Basic Operator Laser Safety
3. Safety First
4. Laser Welding Basics
5. Your First Weld
6. Program Modes and Control Adjustments
7. Computer Control for Customized Settings
8. **OptX** Maintenance Procedures

For specific questions concerning **OptX** device operation, contact Miller Support at email: PWSService@millerwelds.com.

2.8.4 Additional Resources

▼ Table 14. Applicable Standards Resources

Organization	Website / Contact Information
For United States:	
Laser Institute of America (LIA)	Laser Institute of America 13501 Ingenuity Drive, Suite 128, Orlando, Florida 32826 Phone: 407.380.1553, Fax: 407.380.5588 Toll Free: 1-800-34-LASER Email: lia@laserinstitute.org https://www.lia.org
American National Standards Institute (ANSI)	ANSI Z136.1 - American National Standard for the Safe Use of Lasers ANSI Z49.1 - Safety in Welding, Cutting, And Allied Processes https://webstore.ansi.org/
Occupational Safety and Health Administration (OSHA)	OSHA standards for laser hazards: https://www.osha.gov/laser-hazards https://www.osha.gov/otm/section-3-health-hazards/chapter-6 OSHA standards for welding, cutting and brazing: https://www.osha.gov/welding-cutting-brazing
National Fire Protection Association (NFPA)	NFPA 51B - "Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from: NFPA 1 Batterymarch Park Quincy, MA 02169 https://webstore.ansi.org/
Compressed Gas Association (CGA)	CGA publication P-1 - "Precautions for Safe Handling of Compressed Gases in Cylinders", available from: Compressed Gas Association 1401 George Carter Way Chantilly, VA 20151 https://portal.cganet.com/Publication/index.aspx

▼ Table 14. Applicable Standards Resources (Continued)

Organization	Website / Contact Information
For European Union:	
International Electro-technical Commission (IEC)	IEC 60825-1 , Edition 3.0: Safety of laser products - Part 1: Equipment classification, requirements and user's guide IEC 60825-4 Safety of Laser Products - Part 4: Laser Guards (Available through LIA)
International Organization for Standardization (ISO)	https://www.iso.org/home.html
German Institute for Standardization (DIN)	DIN (Deutsches Institut für Normung) https://www.din.de/de
Beuth Verlag	To purchase technical standards: https://www.beuth.de/de
CEN-CENELEC	https://www.cencenelec.eu/
Federal Institute for Occupational Safety & Health (BAUA)	BAUA (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin) https://www.baua.de/DE/Home/Home_node.html
German Social Accident Insurance (DGUV)	DGUV (Deutsche Gesetzliche Unfallversicherung) https://www.dguv.de/en/index.jsp
Association of German Engineers (VDI)	VDI (Verein Deutscher Ingenieure) https://www.vdi.de/richtlinien

IMPORTANT

- Miller requires that the user of this product investigate any local, state or federal requirements as well as facility or building requirements that might apply to installing or using a laser or laser device.
- Ensure that the standard you are using which include, but may not be limited to ANSI, IEC, and OSHA are current.

2.9 Additional Product Specific Safety Features

Additional handheld laser device safety features are discussed in section 7 [▶101] of this Owner's Manual. Ensure you review and understand these important product features listed here.

- **Fiber Interlock** - section 7.1.1 [▶101]
- **External Interlocks** - section 7.1.2 [▶101]
- **Head Nozzle and Workpiece Clamp Interlock** - section 7.1.3 [▶102]
- **Torch Two Level Trigger** - section 7.1.4 [▶102]
- **Overheating Control** - section 7.1.5 [▶102]
- **Plasma Detection** - section 7.1.6 [▶103]
- **Gas Pressure Monitoring** - section 7.1.7 [▶104]
- **Emergency Stop Button** - section 7.1.8 [▶104]
- **Warning and Status Lights** - section 7.1.9 [▶105]

2.10 Activation Code Required at First Power Up

NOTICE

When the **OptX** device is turned ON for the very first time, the system will boot-up into a "locked" state. The unit front panel will be set to "9990", "999", and "99". If the unit is connected to a computer, the web page interface also displays "Unit Locked". When locked the front panel will not allow changes from the two lower knobs. Laser emission cannot be turned on while unit is locked regardless of interlock or alarm state (see Figure 6 [▶60]).

IMPORTANT

To receive the 4-digit activation code, users must first complete the Miller Laser Safety Training webinar. Activation code is provided upon successful completion of training webinar.

When the system arrives there will be a removable label over the keyswitch. Scan the QR code to access the activation portal. Or go to the website:

MillerWelds.com/activateoptx

To activate the **OptX** device complete the safety training webinar and obtain the activation code.

▼ Figure 5. Scan the QR Code to Access the Product Activation Portal



1. Use the **Laser Power** rotary control knob to set the activation code (turn knob counterclockwise).
2. Press and hold both **Mode** buttons until the Mode display starts flashing quickly and then release the buttons (takes ~5 seconds).

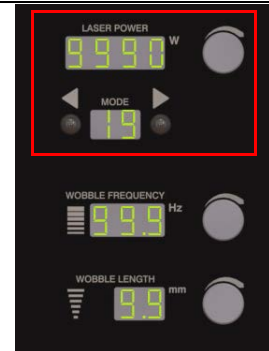
If the inputted code was correct, the displays will update to show the current mode index settings. If code was incorrect the power display will reset back to 9990.

▼ Figure 6. Unit Locked on First Power Up

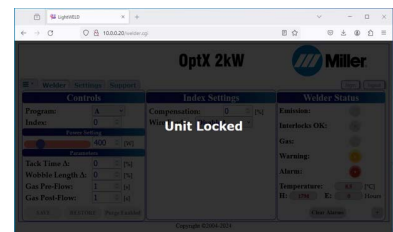
1. Turn Laser Power knob to set activation code



2. Press and hold both mode buttons until mode display starts flashing then release



Unit is Locked



Webpage interface is locked

3 Laser Welder Device Description

3.1 Accessories

The following accessories are included with your Laser Welder Device, as indicated in Table 15 [▶ 61](#).

▼ Table 15. List of Available Accessories

Items	Part Number	Qty	Note
PROVIDED ACCESSORIES			
OptX Handheld Laser Welding and Cleaning System Owner's Manual	OM-296747	1	This document
Power ON/OFF Security Keys	297844	2	For switching ON/OFF the main DC power supply.
Laminated Parameter Chart	297016	1	Chart Listing Available Presets
Laminated Activation Card	296844	1	
OptX Operating Safety Card	296577	1	
Cap, Protective, Fiber Optic Outlet Cap, Protective, Fiber Optic Receiver	296303 296304	1	Protective Cap is used to protect the quartz block. Storage sleeve used to protect the protective cap window and electrical contacts on the fiber bayonet when fiber cable is disconnected from torch
Clamp, Work Sense, 32' (10m) Length	296162	1	Work Sense clamp
Laser Safety Eyewear, OptX, LightWeight Wraparound ^{1,2}	301830	1	(Choice of Size for Best Fit)
Welding Helmet, OptX, Carbon Fiber	301829	1	Carbon Fiber Welding Helmet
Connector, External I/O Interconnect, 12-Pin ¹	296264	1	Mating Connector for 12-pin Interface
Nozzle, OptX, Welding, Conical Nozzle, OptX, Welding, 1-Point Nozzle, OptX, Welding, 2-Point 6mm Nozzle, OptX, Welding, 2-Point 9mm Nozzle, OptX, Welding, Wire Feed	301811 301812 301813 301814 301815	1 1 1 1 1	For OptX Welding Nozzle Kit ¹ (5-Pieces) order part number 301832
Nozzle, OptX, Cleaning, Outside Corner Nozzle, OptX, Cleaning, 1-Point Nozzle, OptX, Cleaning, 2-Point	301819 301820 301821	1 1 1	For OptX Cleaning Nozzle Kit ¹ (3-Pieces) order part number 301833
Protective Window, OptX 2kW, 5pcs ¹	301823	1	Torch Protective Window Replacement - 5 Pack comes standard with unit

▼ Table 15. List of Available Accessories (Continued)

Items	Part Number	Qty	Note
Cover, Protective Laser Torch, OptX 2kW	301798	1	Torch Protective Cover
Cradle, OptX Torch	301803	1	Torch Cradle
Wire Feeder Integration Kit ³	301808	1	Conduit, Wire, Aluminum 0.047" (1.2mm), 11' Length
	301809		Conduit, Wire, Steel 0.045" (1.2mm), 11' Length
Tool, Focus Lens Installation, OptX 2kW	296263	1	Focus lens assembly installation tool
Switch, Door Interlock, 2NC, 32' Length	301804	1	Door Interlock Switch and Cable - 10m
Cable, Ethernet Cat 6, 10' (3.04m) Length ¹	301810	1	Connect Ethernet cable between PC and Weld Unit for webpage access and remote troubleshooting
ADDITIONAL ACCESSORIES AVAILABLE FOR PURCHASE			
Laser Safety Eyewear, OptX, LightWeight Fit-Over ^{1, 2}	301831	1	(Choice of Size for Best Fit)
OptX Wire Feeder	301805	1	3rd Party unit with cable and torch attachment included
Heavy Duty Welding Cart with Wheels ³	301792	1	Cart (assembly required) used to hold weld unit, wire feeder and gas tank
Lens, Focus Assy, OptX 2kW	296267	1	Focus lens assembly

¹. Quantity 1 is included with welding unit. Additional quantities of these accessories may also be purchased separately if needed, in addition to the additional accessories available for purchase.

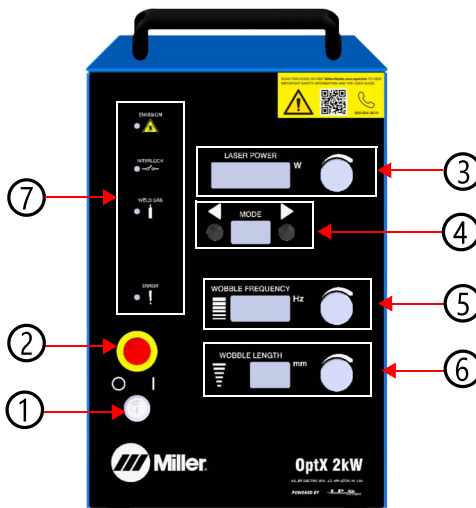
². These pairs specified here are for regions other than the EU. For users in the EU: (1) refer to section 2.2.4 [►29] for laser eyewear criteria; and (2) refer to Table 5 [►31] for listing of laser safety eyewear suppliers in the EU.

³. This product is not available for sale in the EU.

3.2 Weld Unit Front View

Refer to Table 16 [▶63] for a description of all these features and connections.

▼ Table 16. Weld Unit Front Panel Features

Item	Feature	Description
		
1	Keyswitch	- Turn the key clockwise to 1 (ON) position to enable main DC power supply. - Turn the key counterclockwise to 0 (OFF) position to disable the main DC power supply. - Key cannot be removed while in the 1 (ON) position. - Key can be removed in 0 (OFF) position to reduce risk of unauthorized use.
2	Emergency Stop Button (E-Stop)	- Temporarily suspends power to the weld unit. When pressed, the main DC power supply will be disabled. - Once pressed, the E-Stop button can be reset by turning the red knob clockwise.
3	Laser Power Display with Control Knob (in W)	- Manually adjust Laser Output Power by turning the rotary control knob. - Clockwise will increase power. Counter-clockwise will decrease. - Four digit display.
4	Program Display with Mode Selection Buttons	- Use front panel buttons to increment up or down through the programmed recipes. - Programs are identified by two alphanumeric characters (e.g. 10, A1, etc.). - There are 26 user programmable recipes (00 to 25). - There are currently 26 preset modes with an additional 28 preset reserved for future upgrade. Preset program recipes will have a letter followed by a number 0 to 9.

▼ Table 16. Weld Unit Front Panel Features (Continued)

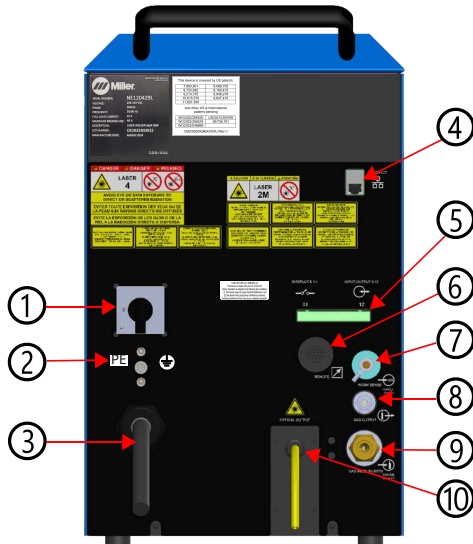
Item	Feature	Description
5	¹ Wobble Frequency Display with Control Knob (Hz)	Manually adjust the Wobble Frequency (frequency of sinusoid) by turning the rotary control knob.
6	¹ Wobble Length Display with Control Knob (mm)	Manually adjust the Wobble Length (line length) by turning the rotary control knob. Affects the magnitude of deflection of the laser beam via the galvanometer.
7	Status Indicator Lights	There are four LED light indicators that are used to show the status of the welder unit. Indicators top to bottom include:
		 Emission - Lit yellow during welding process while laser emission is turned ON. Trigger 2 control on the torch was pressed and all safety interlock loops were satisfied.
		 Interlock - Lit green when all safety interlock loops are satisfied. Once this indicator is lit it means that laser emission can be turned ON by pressing the Trigger 2 control on the torch, provided there are no alarms and gas delay time is met.
		 Weld Gas - Lit green when there is sufficient gas pressure coming into the device from gas supply.
		 Error - Lit red when alarm occurs. Alarms will stop the welding process by shutting down the laser emission.

¹. Knob may control other functions for some laser modes. Refer to Figure 8-1.

3.3 Weld Unit Rear View

Refer to Table 17 [▶65] for a description of the rear panel features and connections.

▼ Table 17. Weld Unit Rear Panel Features

Item	Feature	Description
		
1	AC Power Switch	Turn the handle clockwise to the 1 (ON) position. Turn the handle counterclockwise to the 0 (OFF) position. With the handle in the OFF position, pressing the yellow locking element on the handle allows personnel to install lockout and/or tagout devices.
2	PE Ground Connection	If you are wiring the pigtail to a connector that is not IEC60309 compliant, you must connect the PE ground at the rear of the unit (stud is above the AC line cord).
3	AC Line Cord 10.5ft (3.2m)	 AC connection: 208-240 VAC, single phase, 50/60 Hz, 32A. For installation instructions, refer to section 5.7 [▶82]. The AC line cord has a pigtail that can be wired to one of the following options: (1) Disconnect Device, (2) Connector compliant to IEC60309, or (3) Connector that is not compliant to IEC60309. For Option #3: Must connect PE Ground at the stud that is located on the rear panel of the device (above AC line cord). See Item #2 above.

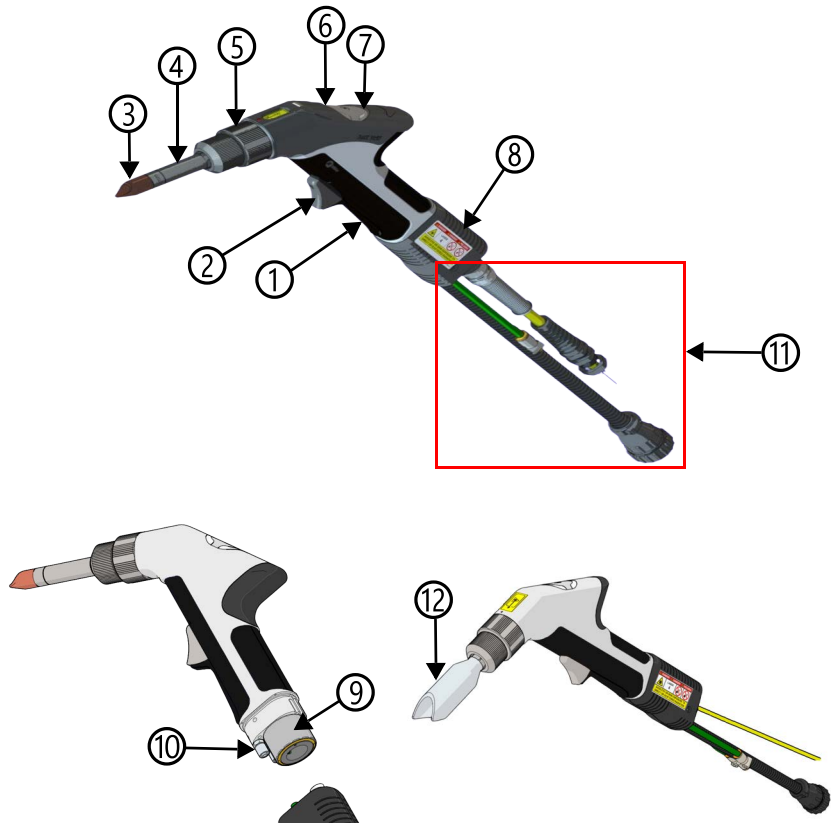
▼ Table 17. Weld Unit Rear Panel Features (Continued)

Item	Feature	Description
4	Ethernet Port	Standard 10/100 Ethernet Communication Port. Ethernet connection to customer host computer. RJ-45 Connector. Use shielded Ethernet Cable. Access web page interface for welder status troubleshooting, program creation/management, and IP configuration. Firmware is also updated through this connection.
5	12-pin Interface Connection	I/O connector for wiring external interlocks, laser active interface and wire feeder integration.
6	Torch Interface Connection	Cable connection to the torch (power, I/O, etc). Cable is routed through the umbilical.
7	M8 Shank for Work Sense Clamp Cable	Work Sense clamp cable attaches to this threaded M8 shank. This closes the safety interlock loop between the welder nozzle tip and this shank. It ensures the torch is connected to the workpiece before emission can safely be turned ON.
8	Gas Output to Torch	This tubing is routed through the umbilical.
9	Gas Input from Tank	Connect 1/2 inch OD flexible tubing from gas supply tank to rear panel input port.
10	Laser Output Fiber Cable [Length is 10m (32.8ft)]	 The output of the laser (fiber cable) is delivered through this location and attaches to the torch (QBH output termination). Infrared radiation is delivered to the torch through this fiber. Fiber cable is routed through the umbilical.

3.4 Hand Laser Torch

Refer to Table 18 [▶67] for a description of the torch features and connections.

▼ Table 18. Torch Feature Descriptions

Item	Feature	Description
		
1	Trigger 1 - Start Gas Flow	Press and hold Trigger 1 to begin shielding gas flow. This must remain pressed throughout the welding process. Trigger 1 should only be released once Trigger 2 is no longer being pressed.
2	Trigger 2 - Start Laser Emission	 This switch acts as a start button for the laser. When this is pressed, the laser will fire provided the safety conditions are satisfied and shield gas has been detected for at least 1.5 second prior.
3	Nozzle Tip	Five copper nozzle tips come with the system. Refer to Table 26 [▶108] for the nozzle selection chart.
4	Extension Tube	Nozzle tips are threaded onto this tube.
5	Collet Chuck Assembly	Used to open and gain access to the protective window for inspection and/or replacement. Refer to maintenance section A.1.1 [▶156].

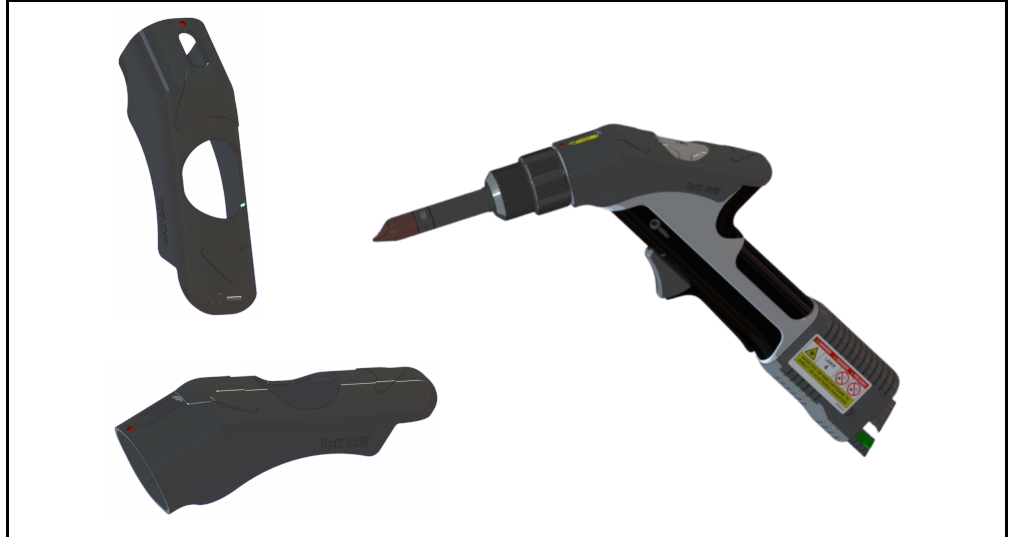
▼ Table 18. Torch Feature Descriptions (Continued)

Item	Feature	Description
6	Red Emission ON Status Indicator	 This will be lit red while laser emission is turned ON.
7	Green Status Indicator Light	• Solid Green - while Trigger 1 is pressed and no errors are present. • Blinking Green - once all the interlocks are fully satisfied. This indicates that the system is ready to fire. Operator can now press Trigger 2 control to start the laser emission.
8	Boot	Boot is removable and will conceal the fiber cable, gas tubing and torch electrical and I/O cable.
9	QBH Fiber Cable Connection	The unit will arrive with the fiber cable already inserted and connected to torch.
10	Gas Line Connection	Shield gas tubing is routed through the torch boot.
11	Cabling Routed Through Umbilical	Picture is showing: (1) gas tubing, (2) yellow laser fiber cable and (3) torch I/O cable. These are routed through the black umbilical and are not normally visible during normal operation.
12	Cleaning Nozzle	It is intended to be used while operating the device in laser cleaning mode which enables a beam wobble length adjustment up to 15 mm. Three cleaning nozzles come with the system. Refer to Table 26 [▶108] for the nozzle selection chart.

3.4.1 Torch Protective Accessories

To prevent damage to the torch, use the protective cover and cradle. When the device is not in use, place the torch in the cradle as shown in the figure below.

▼ Figure 7. Torch Protective Cover (#301798)



▼ Figure 8. Torch Cradle (#301803)



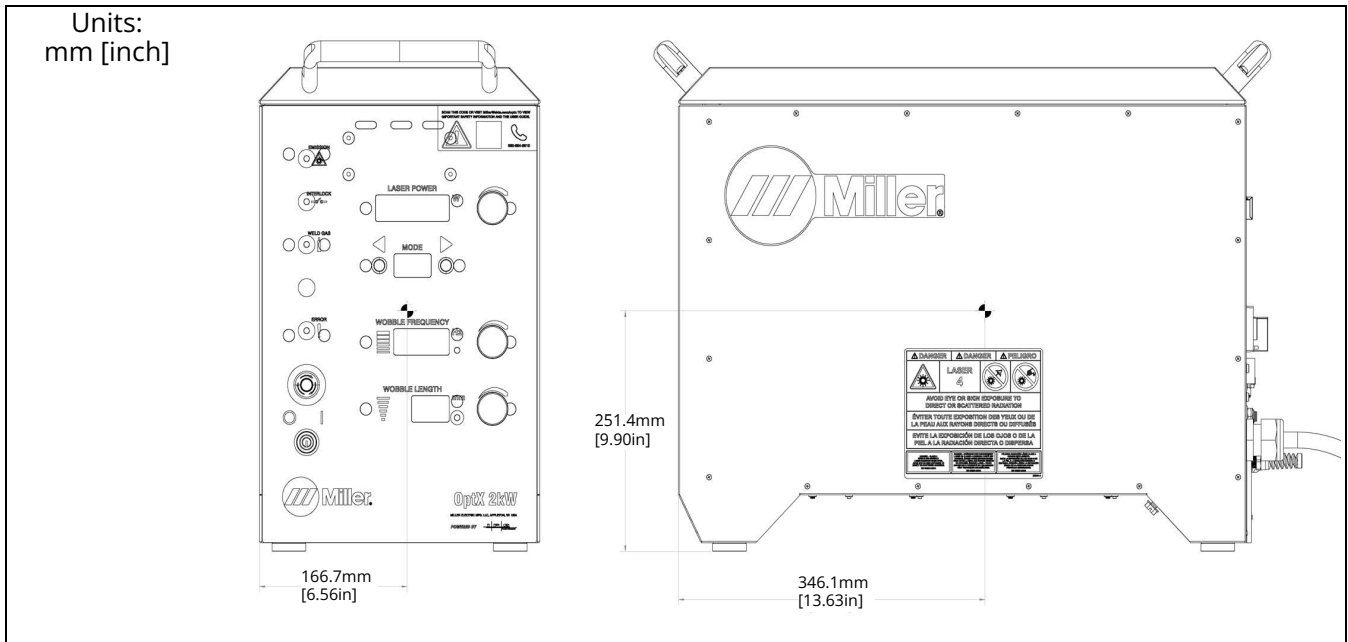
3.5 Layout and Dimensions

Welder unit dimensions are indicated in the figure below. See Figure 10 [▶ 71] for the unit's center of gravity location.

▼ Figure 9. Device Layout and Dimensions

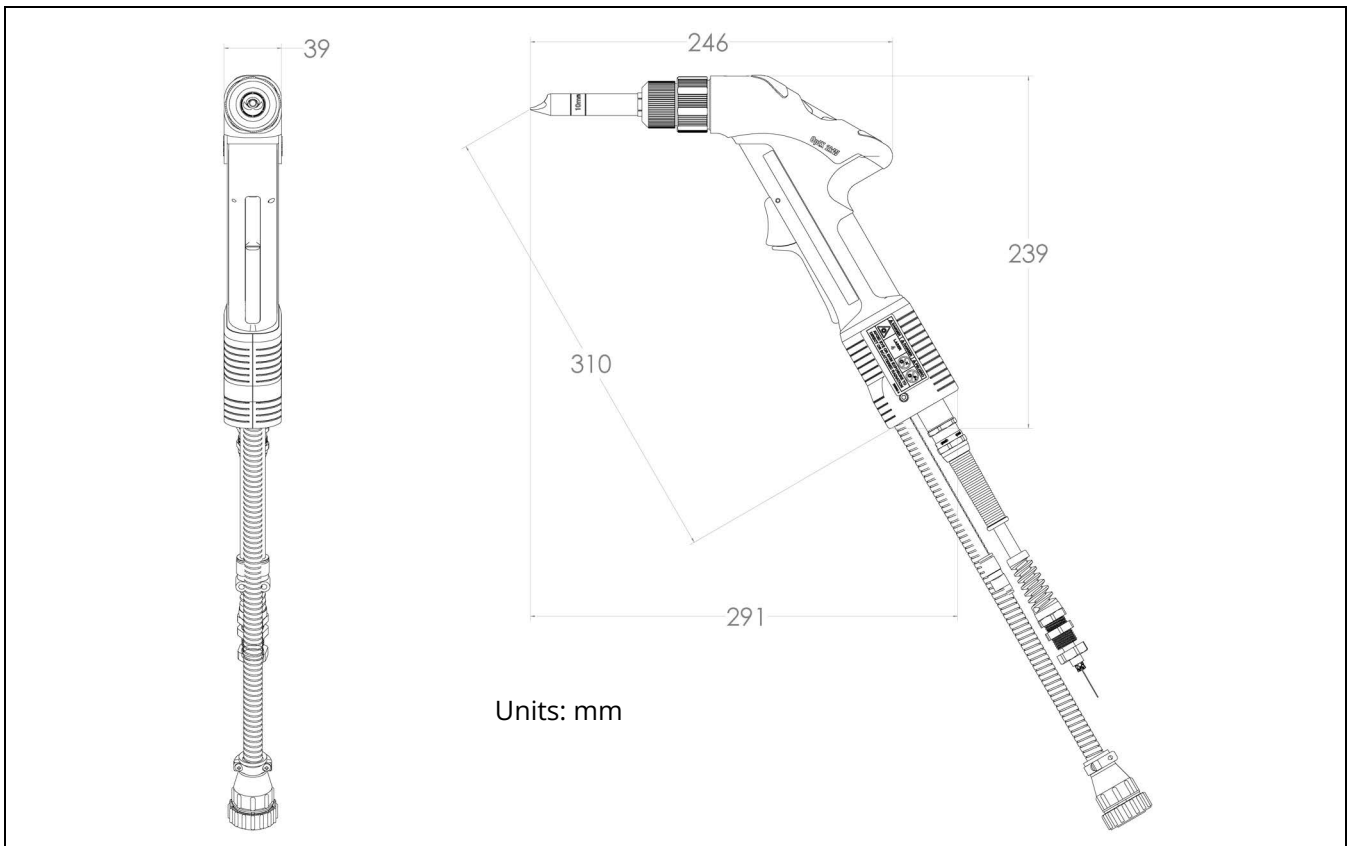


▼ Figure 10. Center of Gravity



Torch dimensions are indicated in the drawing below.

▼ Figure 11. Torch Layout and Dimensions



3.6 Fiber Cable Output Connection

IMPORTANT

The OptX-series welder system will arrive with the fiber cable already inserted and connected to the torch. Should it become necessary to disconnect and reconnect the fiber (e.g. need to replace torch), refer to Maintenance Appendix section A.2 [▶ 161].

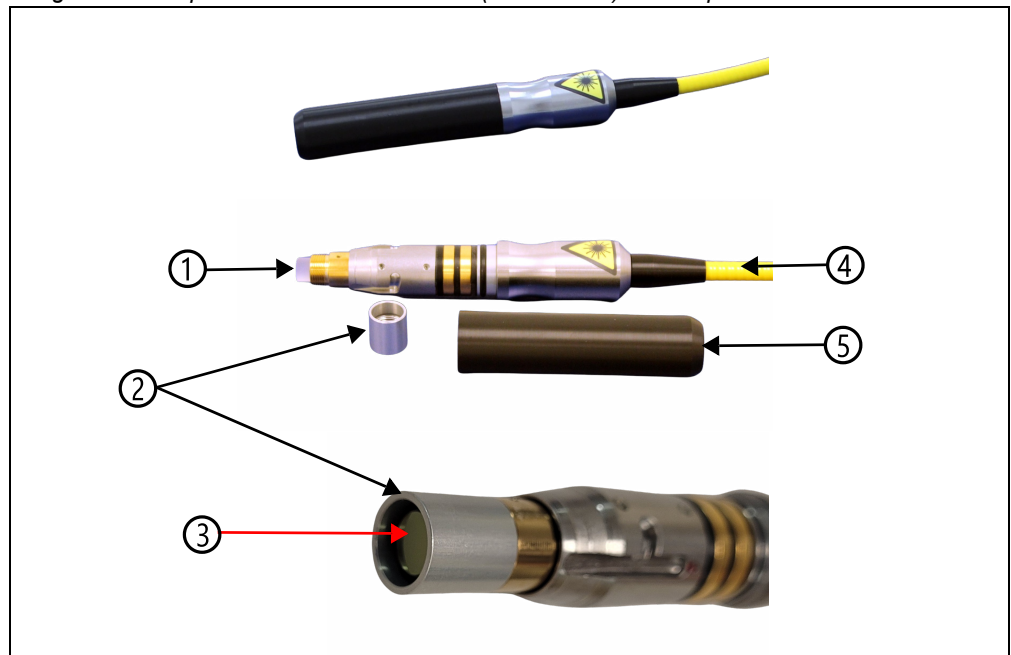
The end connector of the fiber uses a protective cap that covers and protects the optical surface of the quartz block and a storage sleeve that protects the protective cap window and electrical contacts when not in use. Remove the storage sleeve from the connector immediately before optical cleaning and connecting to torch.

NOTICE

It is imperative that a fiber termination is checked for dust, dirt, or damage every time the fiber cable is disconnected from the torch.

For more detailed information on proper cleaning procedures, refer to the output termination cleaning guide that is found in the Maintenance Appendix section A.3 [▶ 165].

▼ Figure 12. Optical Fiber End Connector (Model LC-8) with Cap and Sleeve



Item	Designation	Item	Designation
1	Quartz Block	2	Protective Cap
3	Protective Cap Window	4	Fiber
5	Cap, Protective, Fiber Optic Outlet (#296303)	--	--

4 Delivery and Transport

This chapter provides information regarding the delivery, transport and unpacking of the handheld laser welding system.

4.1 Delivery

The welding system is shipped in a foam insulated collapsible crate with foam shock absorbers and impact indicators to help secure and ensure safe handling during shipping.

Special care is recommended when unpacking. To minimize the risk of damage to the unit, Miller recommends that you unpack the unit using the instructions provided in section 4.2 [▶ 73].

IMPORTANT

- ▶ If the packaging shows any signs of external damage, check unit for damages and notify the shipping agent and Miller immediately.
- ▶ Particular care must be taken when you remove the unit from the packing case to ensure that the fiber optic cable is not broken or damaged.

4.2 Unpacking from Shipping Container

IMPORTANT

Miller recommends the following when unpacking the unit:

- ▶ Only work with suitable tools and aids
- ▶ Follow all steps to ensure safe unpacking of the products
- ▶ Always wear protective clothing

Refer to Figure 13 [▶ 74] and Figure [▶ 74] for an illustration of this procedure.

1. Use pallet jack to move crate to unpacking location. Crate must be placed on a stable surface. Remove the outer plastic wrap.
2. Remove the top lid and top foam insert.
3. The fiber umbilical will be looped and tie wrapped. The laser torch will also be wrapped. Using a cutting tool remove the tie wraps securing the fiber to the second insert.

NOTICE

Umbilical cable handling

Severe laser damage will occur if optical fiber cable, routed through the umbilical, is mishandled (extreme bending, pulling or impact).

- ▶ Do not bend the yellow optical fiber cable to a radius less than 50 mm minimum bending radius.
- ▶ Do not apply excessive load or impact to the fiber cable.
- ▶ NEVER move or lift the unit by pulling or dragging on the umbilical cabling.

4. Carefully place the umbilical and torch on top of the unit.
5. Remove the crate side panels. To remove unit from crate, pick it up using the two handles at the top of the unit. Miller strongly recommends for two people to lift the unit at all times. Be careful when handling the umbilical and torch.

CAUTION**Avoid injury due to heavy weight - 72 kg (160 lb)**

Physical injuries are possible when attempting to carry the unit alone.

- Always handle the welding unit with 2 persons.
- Manual handling only for limited time/distance.
- No manual handling by persons with impaired physical performance.
- Use material handling gear for long distance transport.

6. A comprehensive packing list is included with the system documentation. Check all items in the crate against this list.

IMPORTANT

- Contact Miller immediately if any of the items are missing or if any damage to the unit is evident. If any damage to the unit is evident or suspected, do not attempt to install or operate the laser device in any case.

7. Retain all packaging for future transportation or storage needs.

▼ Figure 13. Domestic Shipments - Collapsible Crate



4.3 Transport to Installation Location

NOTICE**Umbilical cable handling**

Severe laser damage will occur if optical fiber cable, routed through the umbilical, is mishandled (extreme bending, pulling or impact).

- Do not bend the yellow optical fiber cable to a radius less than 50 mm minimum bending radius.
- Do not apply excessive load or impact to the fiber cable.
- NEVER move or lift the unit by pulling or dragging on the umbilical cabling.

NOTICE**Avoid damage during transport**

Always transport the laser welder in the upright position.

If the installation site is a long distance away, carefully place the umbilical on top of the laser welder.

Using 2 people, pick up the device and load it onto a wheeled cart that is able to support the weight of the device and accessories.

Transport the laser welder to the installation site.

⚠ CAUTION**Avoid injury due to heavy weight - 72 kg (160 lb)**

Physical injuries are possible when attempting to carry the unit alone.

- Always handle the welding unit with 2 persons.
 - Manual handling only for limited time/distance.
 - No manual handling by persons with impaired physical performance.
 - Use material handling gear for long distance transport.
-

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5 Installing Welding Device

5.1 Precautions

Personnel Qualifications: Maintenance Personnel and Electrician (see section 1.4 [▶18]).

NOTICE

Incorrect voltage and wiring can damage the welder system.

Ensure the voltage and wiring is correct prior to turning ON the power.

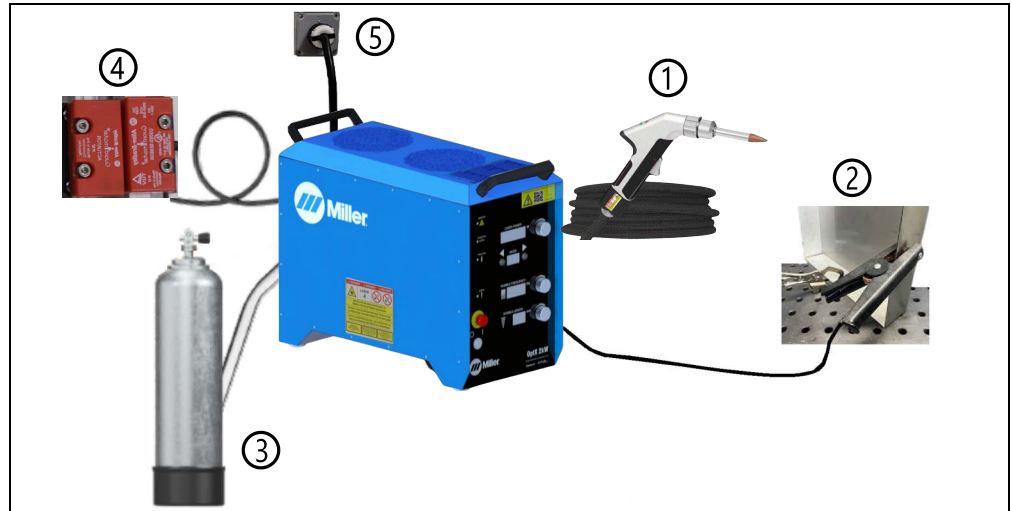
- ▶ Refer to the specification for proper electrical power requirements.
- ▶ Ensure that the incoming voltage is equal to the level noted in the specification.

IMPORTANT

Airflow capacity

Operate only in an environment with sufficient airflow capacity that allows for the specified heat load developed during operation.

▼ Figure 14. Connecting the Equipment

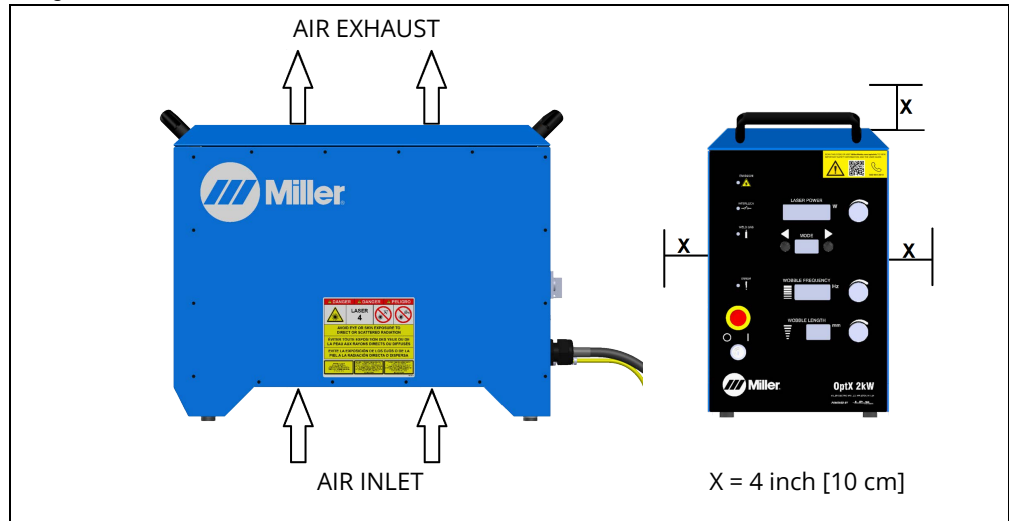


Item	Designation	Item	Designation
1	Laser Light and Gas Controls. Umbilical is 10 meters.	2	Work Sense Clamp Cable
3	Weld Gas	4	Environment Safety Interlocks
5	208-240 VAC	--	--

5.2 Air Flow and Installation Clearances

The laser welder unit is air cooled. In choosing the location to install the unit, make sure to leave approximately a 4 inch (10 cm) clearance above and to the left and right of the unit. Never place any objects on top of the unit that can block the air exhaust. The direction of the airflow is illustrated in Figure 15 [► 78].

▼ Figure 15. Unit Air Flow and Installation Clearances



5.3 Connect Work Sense Clamp Cable

A threaded M8 shank exits the back panel. The clamp cable must be attached to this shank (torque 35 in-lbf) and either the workpiece or the electrically conductive welding table on which the workpiece is placed is clamped before the laser can be turned ON. This closes a safety interlock loop between the welder nozzle tip and this shank.

▼ Figure 16. Connect Work Sense Clamp Cable to Shank



5.4 Connect Welding Gas

IMPORTANT

Pressure regulator selection

A single-stage pressure regulator with 50 psi maximum output is recommended for use with the **OptX** system. A flow regulator is not recommended as it may not provide sufficient gas pressure to the system.

Welding Gas specifications and connection to the back of the unit are specified in Table 19 [▶ 79]. Once connection is made, turn on the gas supply.

WARNING



Placement and securing of gas cylinders

Gas cylinders can explode if damaged or placed nearby to the welding area causing injury and property damage. Injury is also possible if cylinder tips over.

- Gas cylinders should be shielded and located in areas where they cannot be struck or damaged.
- Place them away from sources of heat, sparks or flame, as well as deflection from laser beam.
- Cylinder must be stored upright and secured to a fixed support.

▼ Table 19. Shield Gas Specifications

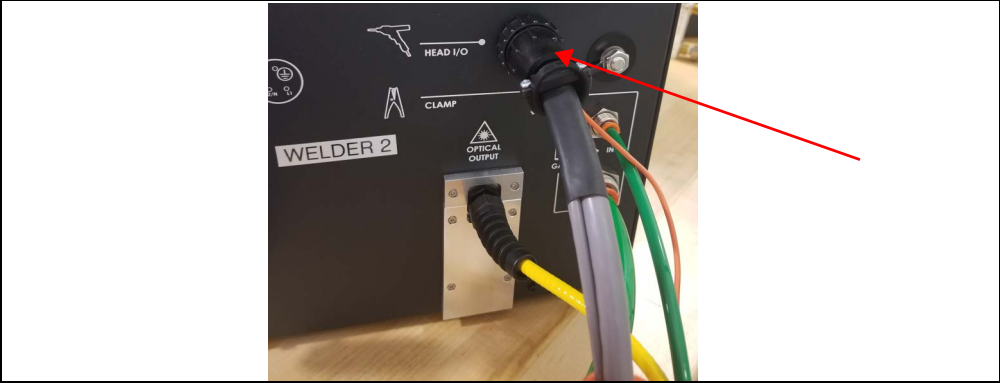
Characteristic	Specification
Standard Welding Gas	• Argon • Nitrogen • Argon + CO₂ mix
Gas Pressure to Weld Unit Input	• 20-30 psi (138-207 kPa)
Welding Gas Connections on Rear Panel	• Facility Gas Line: Connect customer-supplied gas hose, with 5/8"-18 threaded connector, to rear panel gas input. • Gas Line from Unit to Torch: The 1/4 inch gas line from unit to torch will already be installed and connected at the factory. This poly tubing is routed through the umbilical.



5.5 Connect Torch I/O Cable

Connect the torch I/O cable on the rear panel as indicated in Figure 17 [▶ 80]. This cable is routed through the umbilical. It will already be connected to the torch upon arrival.

▼ Figure 17. Connect Torch I/O Cable



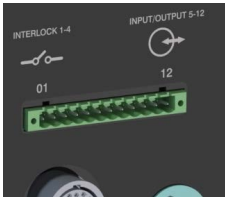
5.6 Customer Interface Connections

The section describes the ports used to interface with the laser welder. The 12-pin connector provides a hardware interface to the unit that enables user to integrate external safety interlocks, power supply active warning indicators, integration of pedal and wire feeder. The Ethernet connection is used to access the webpage interface.

5.6.1 12-pin Interface Connector and Pinout

The 12-pin I/O connector is located on the rear panel of the device (as shown). For pinout information, refer to Table 20 [▶ 80].

▼ Table 20. 12-pin Interface Connection and Pinout Table

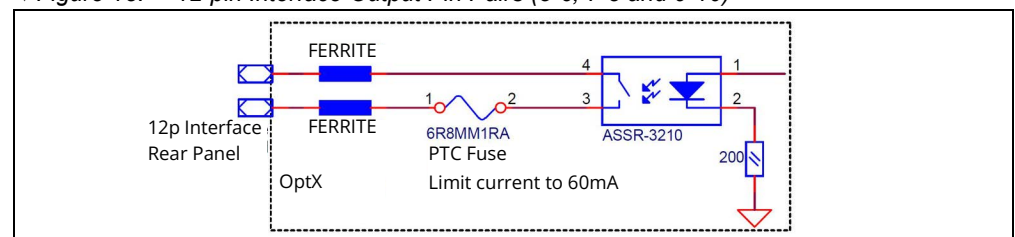
Pin	Signal Name	Type	Notes
MOUNTED ON REAR PANEL  Phoenix Terminal Block 1777170 12 Position Terminal Block Header, Male Pins, Shrouded (4 side) 0.200" (5.08mm) Vertical Through Hole			CABLE MATING CONNECTOR (Miller Part Number: 296264)  Phoenix Mating Connector 1754898 12 position Terminal Block Plug, Female Sockets 0.200" (5.08mm) 180° Free Hanging (In-Line).
1	¹ External Interlock A+	Contact Closure ²	External Safety Interlock Loop A. Laser cannot be started without the required safety interlocks being in place and satisfied.
2	¹ External Interlock A-		
3	¹ External Interlock B+	Contact Closure ²	External Safety Interlock Loop B. Laser cannot be started without the required safety interlocks being in place and satisfied.
4	¹ External Interlock B-		

▼ Table 20. 12-pin Interface Connection and Pinout Table (Continued)

Pin	Signal Name	Type	Notes
5	³ Power Supply Enabled+	Contact Closure ⁴	Output is normally open. The 5-6 contacts close when the power supply on the laser driver is enabled or told to be enabled. Note that this only means laser power supply is on, not the main unit power supply. Refer to both Figure 18 [► 81] and note "4".
6	³ Power Supply Enabled-		
7	³ Switch Enabled+	Contact Closure ⁴	Output is normally open. The 7-8 contacts close when the switch enable on the laser driver is enabled or told to be enabled. Refer to both Figure 18 [► 81] and note "4".
8	³ Switch Enabled-		
9	GPO+	Contact Closure ⁴	General Purpose Output for optional wire feeder. Normally open. Closed if the output is active. The 9-10 contacts close when trigger 2 is pressed and enables the wire feeder start. Refer to Figure 18 [► 81] and note "4".
10	GPO-		
11	Reserved	----	----
12	Reserved	----	----

1. External Interlock Loops A and B should both be wired to same safety function. They should be redundant on same door, for example. These are NOT intended to be two independent safety interlocks.
2. Contact Closure: Connection of potential free contacts only. Do not connect an external voltage.
3. Pins 5-6 and 7-8 are redundant outputs for safety to indicate that laser emission is ON or could be ON. These outputs may be used to turn on a light tower, buzzer or laser emission LED, as examples.
4. Output is an opto-isolated solid state relay output. **Current output must be limited to <60 mA** (fused by an 80 mA PTC). Contact closure could be used to drive PLC digital input or use with relay to drive larger currents. 24 V compliant if current limited to <60mA. **Switched voltage must be 40 Volts or less.**

▼ Figure 18. 12-pin Interface Output Pin Pairs (5-6, 7-8 and 9-10)



5.7 Connect Electrical Power

Personnel Qualifications: Electrician (see section 1.4 [▶18]).

Refer to the laser welder's *PRODUCT SPECIFICATION* for power requirements. An AC line cord with pigtail is provided with your laser welder.

▼ Table 21. Wiring AC Line Input

Characteristic	Specification
Input AC Voltage	208-240 V, single phase
Full Load Current	32 A
Input AC Frequency	50/60 Hz
Maximum Rated Power	6000 VA
AC Connection	The AC line cord has a pigtail that can be wired to one of the following options: 1. Disconnect Device (refer to section 5.7.1 [▶82]) 2. Connector that is compliant to IEC60309 standard 3. Connector that is not compliant to IEC60309 standard For Option #3: Must connect PE Ground that is located on the rear panel of the device (above AC line cord). The PE Ground is a threaded hole for a #12-24 screw. Use 10 AWG copper wire for PE ground connection. Wire the power input to the voltage, phase and frequency indicated. L1 Line Voltage = black L2 (or N in EU) = white PE Ground = green
Cordage Specification	10.5ft (3.2m) cord with pigtail is provided. Portable Cordage 3 Conductor Type SOOW 600V 10AWG (104x30) 90°C. General cable 2728 or equivalent.



5.7.1 Wiring the AC Line Cord Pigtail

NOTICE

Incorrect voltage and wiring can damage the welder system.

Ensure the voltage and wiring is correct prior to turning ON the power.

- See rating label on unit and check input voltage available at site. Ensure that the incoming voltage is equal to the level specified.
- Installation must meet all National and Local Codes.
- Disconnect and lockout/tagout input power before connecting input conductors from unit. Follow established procedures regarding the installation and removal of lockout/tagout devices.
- Always connect green conductor to supply grounding terminal first and never to a line terminal.
- The electrical connection to the unit must be connected to an individual branch circuit with a circuit breaker or fuse that does not exceed 40 Amps. This must be in close proximity to the unit and within easy reach of the operator and marked as the disconnecting device for the unit.

⚠ DANGER

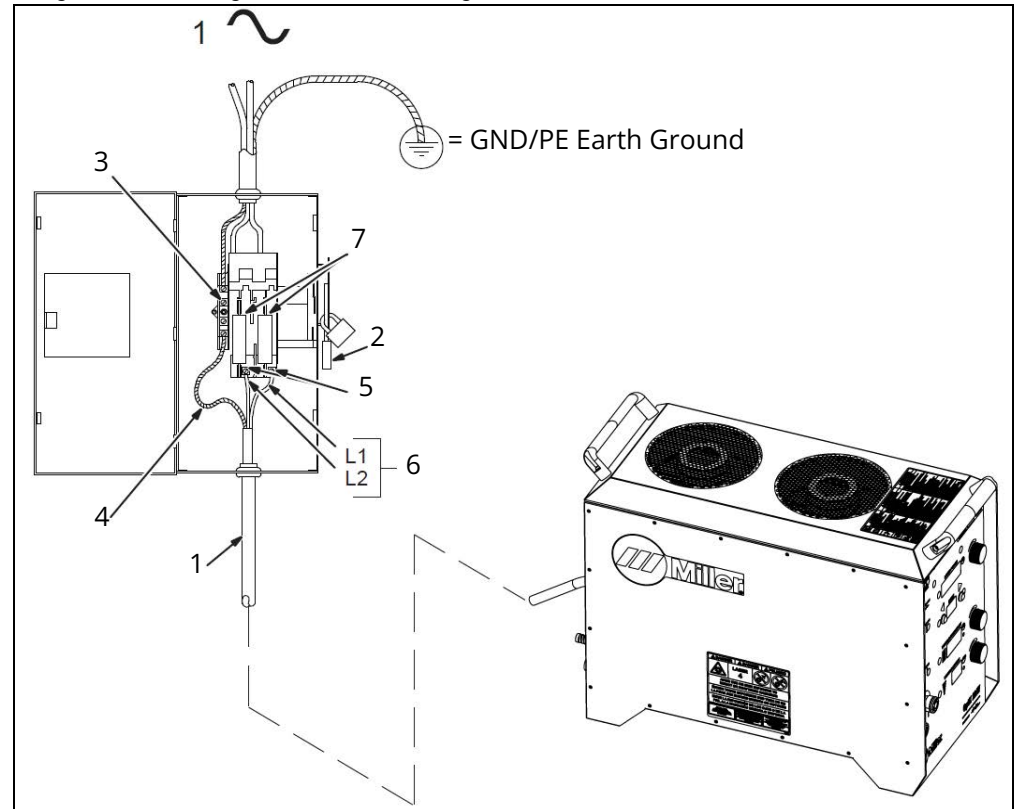
Exposed electrical components. Danger to life due to electrical shock.

- Installation exclusively by qualified personnel that are knowledgeable in electrical safety practices.

Refer to Figure 19 [▶ 83].

1. Input Power Conductors.
2. Disconnect Device. The switch is shown in the OFF position.
3. Disconnect Device (Supply) Grounding Terminal.
4. Connect green grounding conductor to disconnect device grounding terminal.
5. Disconnect Device Line Terminals.
6. Connect input conductors L1 and L2 to disconnect device line terminals.
7. Over-Current Protection.
 - Circuit breaker or fuse rating must not exceed 40 amperes (fused disconnect switch shown).
8. Close and secure door on disconnect device.
9. Follow established lockout/tagout procedures to put unit in service.

▼ Figure 19. Wiring the AC Line Cord Pigtail to the Disconnect Device



5.7.2 Connections to External Circuits

Except for Mains connection, the external connections between this product and other external devices are PELV (Protected Extra Low Voltage) as defined by IEC 61140. Non-Mains outputs of other devices connected to this product should also be PELV or SELV (Safety Extra Low Voltage).

5.7.3 Operating in the Vicinity of GTAW Equipment

NOTICE

To prevent damage, isolate the OptX device

The **OptX** device is designed to operate in industrial environments; However, care should be taken to isolate the **OptX** device from the area where GTAW equipment is being operated whenever possible.

When operating GTAW (TIG) equipment in AC mode, high frequency is used to stabilize the arc. This high-frequency radiation travels through any cable or conductor electrically connected to the power supply. It also radiates back into the shop electrical input lines and is propagated through the air as radio waves. Ensuring that all GTAW equipment is properly grounded and shielded are important for safe operation. Improper grounding and shielding can lead to direct emission of high-frequency radiation, which can cause damage to equipment in the area.

Suggested best practices:

- Establish a welding zone: A circle 50 ft (15 m) radius from the midpoint between high-frequency source and weld torch in all directions.
- Welding zone: Ensure all metal machine cases, work output terminal, line disconnect device, input supply, and welding table in the welding zone are connected to earth ground using #12 AWG wire.
- Weld Cables: Keep weld cables as short as possible and close together.
- Conduit in welding zone: Electrically bond all sections of conduit in welding zone together using copper straps or braided wire.
- Pipes: Ground water pipes every 50 ft (15 m).
- Materials: Bolt or weld metal building panels together and install copper straps or braided wire across joints. Ensure building frame is grounded.

5.8 Laser Controlled Area Door Interlock Example

Personnel Qualifications: Maintenance Personnel (see section 1.4 [▶18](#)).

A 4-wire door switch is shown in the example found in section 5.8.1 [▶85](#).

DANGER

Class 4 invisible laser radiation

Do not defeat, tamper, remove, or bypass the door interlock. Severe injury to personnel could result.

- The **OptX** device is a Class 4 laser device and safety standards (ANSI Z136.1) call for it to be operated within a Laser Controlled Area that is equipped with safety controls which are activated upon entry of personnel into the Laser Controlled Area.
- The **OptX** device utilizes a dual channel interlock safety system which shuts off the laser power supply when the user integrated entry sensors detect an opening into the Laser Controlled Area. This prevents access to laser radiation above applicable exposure levels.

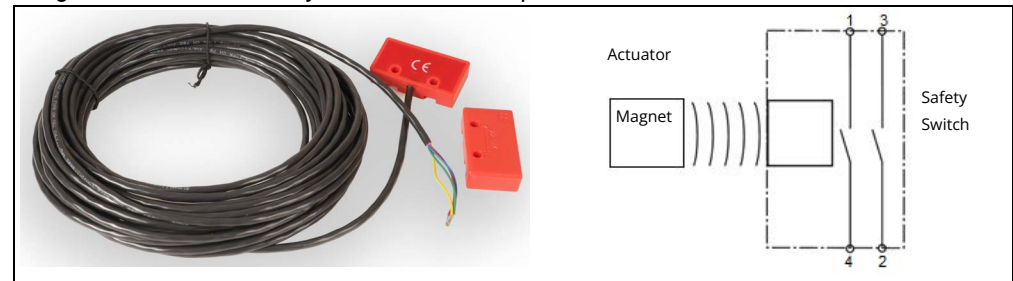
5.8.1 Door Switch Entry Interlock Example

Many types of door switches are available, and their operation, in most cases, is similar to floor mats or optical sensors used for the same purpose.

In the example shown in Figure 20 [▶ 85], the door switch is comprised of two components: A switch unit with cable attached, typically fixed to the door frame; and the magnetic actuator usually mounted to the door in a position where it will activate the switch. The switch contains two contacts that close when proximate to the actuator (e.g., door is closed) and otherwise are open.

The documentation supplied with the switch will identify the different conductors in the cable or connector. Attention must be paid to wiring correctly and the protection of wiring from damage to avoid cross circuit short.

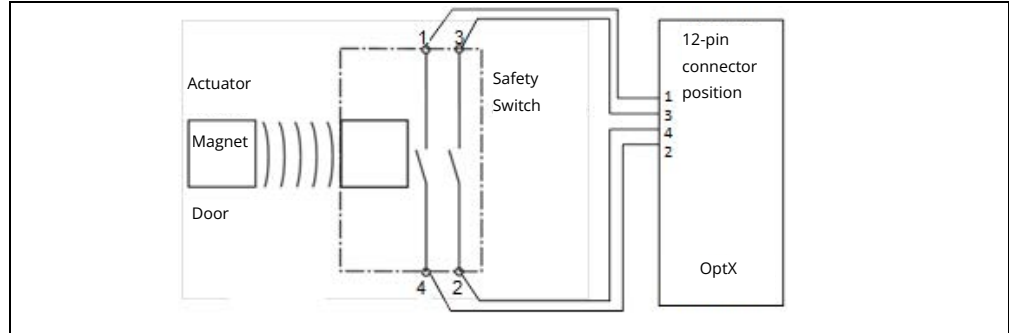
▼ Figure 20. Allen-Bradley Door Switch Example Case



▼ Table 22. Door Switch to OptX Connector Wiring for Allen-Bradley Example Case

Miller Part #: 301804 Door Switch Wire	OptX Device 12-pin Connector
1 - Blue	Pin-1 (External Interlock A+)
4 - Red	Pin-2 (External Interlock A-)
3 - Green	Pin-3 (External Interlock B+)
2 - Yellow	Pin-4 (External Interlock B-)

▼ Figure 21. Interconnection example for the door interlock integration in the OptX device safety logic



NOTE**: Safety switch incorporating 2 separate circuits and 4 contacts

The **OptX** device has redundant interlock circuits. The **OptX** device requires these interlock circuits to be closed for the laser to operate (contact pairs 1-2 and 3-4, refer to Table 20 [▶ 80]). The table above indicates the wiring of the Allen-Bradley switch to the **OptX** device.

Besides door switches, other safeguards such as safety light curtains, safety floor mats, or other safety devices may be connected to secure access to the Laser Controlled Area.

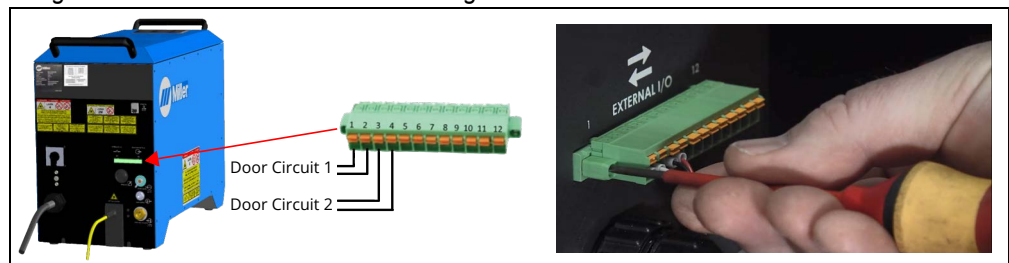
To integrate additional safety features (e.g. external e-stop) all safety related signals shall be connected to the safety logic of the laser controlled area (LCA). These signals form together the enable signal for the **OptX** device. This enable signal of the safety logic has to be connected to the I/O connector on the rear panel of the **OptX** device.

Additional safeguards may be wired in series with the door interlocks such that all safeguards must be satisfied to allow laser operation.

Connection to the **OptX** device is made to the 12-position terminal connector. Connections are made by pushing down on the orange tab, inserting the stripped wire and then releasing the tab. Plug in the cable mating connector into the back of the unit and screw in place.

Note these preferred requirements when selecting which door switch to buy. If the safety door switch selected only contains a single NC output, then install two door switches, one for each circuit.

▼ Figure 22. Terminal Connection and Tighten Connector Screws to Secure Connector



5.8.2 Mounting the Door Switch

These are mounting instructions for the Allen-Bradley door switch. If purchasing an alternate door switch, follow the instructions provided with that switch.

IMPORTANT

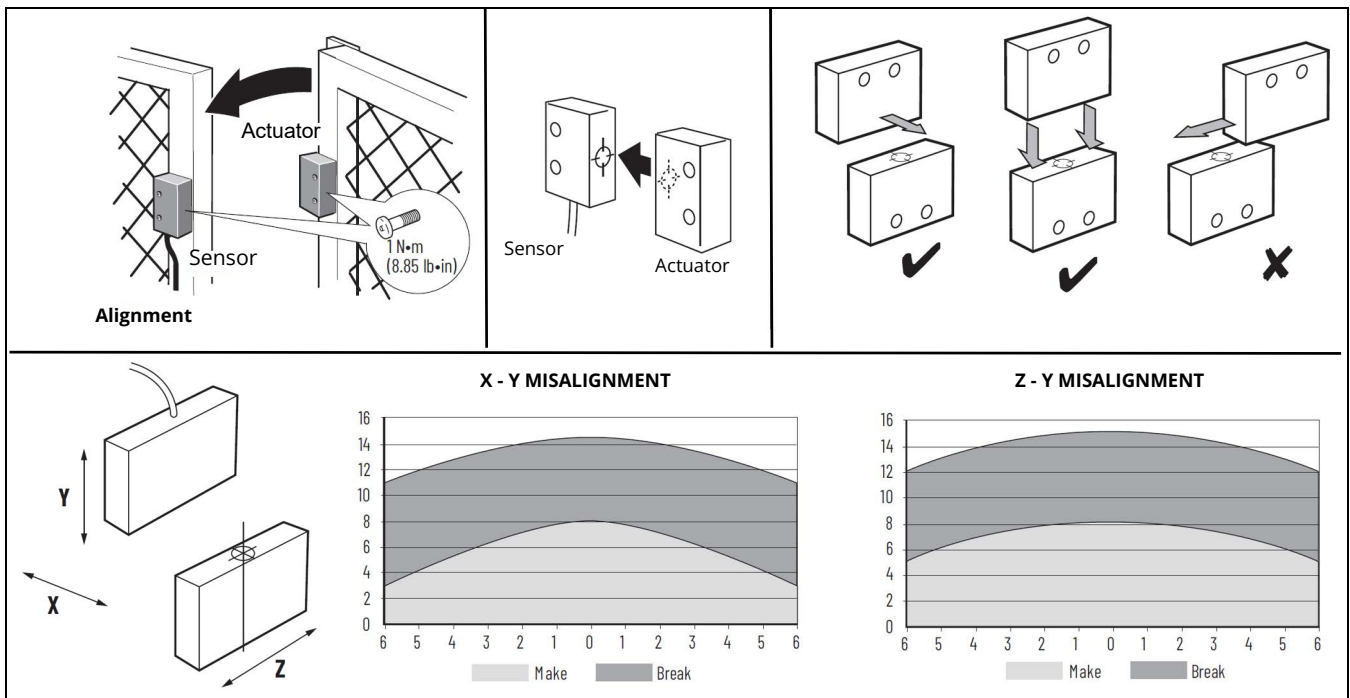
- Maintain 5 mm (0.2 in) clearance from ferrous surroundings.
- After installation and commissioning, the actuator, switch and switch mounting screws should be coated with tamper-evident varnish or similar compound.
- Do not use anaerobic adhesive.
- After installation, verify that the **OptX** device is stopped whenever the interlocked guard door is open. Refer to section 5.8.3 [▶ 88].
- Every week, check the correct operation of the switching circuit. Also check for signs of abuse or tampering. Inspect the switch casing for damage.
- Do not dismantle the door switch. If there is any malfunction or damage, no attempts at repair should be made. The unit should be replaced before system operation is allowed.

The specifications for this door switch are in the table below.

▼ Table 23. Specifications for Allen-Bradley Example Door Switch (301804)

Attribute	Value
Switching distance, max (safety)	Make: 8mm (0.31 in) Break: 14 mm (0.55 in)
Operating temperature	-10...+55°C (14...131° F)
Mechanical life	1 x 10 ⁶
Torque settings, max	1.0 N·m (8.85 lb·in) mounting bolts

▼ Figure 23. Mounting Alignment of Door Switch Sensor and Actuator



5.8.3 Testing Door Entry Safety Interlocks

IMPORTANT

- The cumulative interlock status can be viewed by either: (1) light indicator on front panel; or (2) the webpage interface if the unit is connected to a computer (see section 9 [▶127]).
- More detailed information on the state of each type of interlock is available through the webpage interface.
- The signals External Interlock A and B are not satisfied, if the door interlock is open. The indicators External A and B OK in the webpage Welder Status are not lit.

IMPORTANT

- The front panel indicator shows the cumulative interlock status for all interlocks (all interlocks must be satisfied for this indicator to be lit green).
- **Once the Interlock Indicator on the front panel is lit green it means laser emission can be turned ON.**

DANGER



Class 4 invisible laser radiation

Personnel can be exposed to reflected or scattered laser beams if Trigger 2 switch on the torch is accidentally pressed during this procedure. Permanent and severe eye damage, vision impairment and/or skin burns can occur.

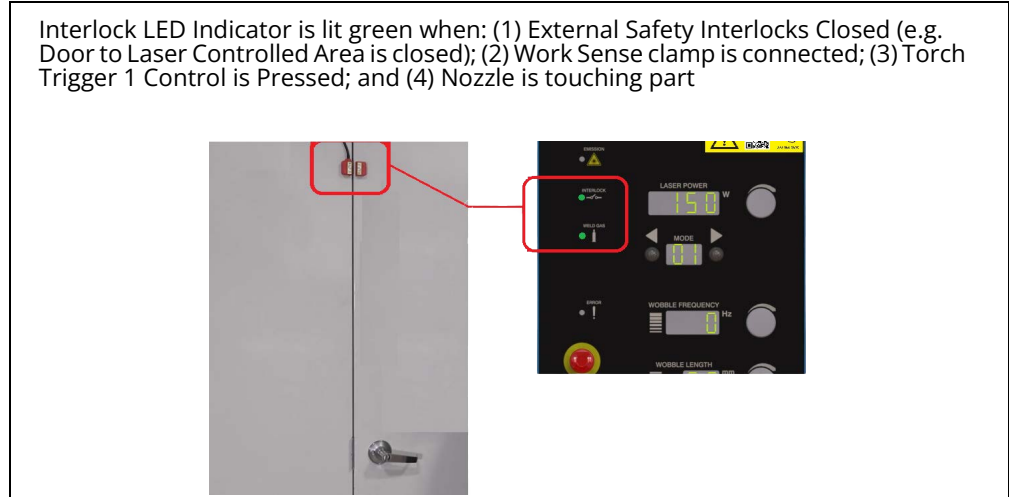
- Make sure Trigger 2 is not pressed during the door interlock test.
- Never position the torch towards the door under test.
- Provide additional safety measures to protect all persons involved in the door interlock test.
- Provide additional safety measures to protect personnel outside of the LCA during the door interlock test.
- All persons must wear PPE prior to testing that the external safety interlocks are wired correctly.
- Required PPE includes: (1) Miller laser safety eyewear, (2) welding helmet with appropriate filters and face shield, and (3) heat-resistant protective gloves and clothing.

1. Power up the **OptX** device. Proceed to section 5.9 [▶90] and then come back to this section once the unit is turned ON.
2. Confirm that the Interlock LED indicator is lit green (Figure 24 [▶89]) when: (a) the interlocked door is closed; (b) the Work Sense clamp is connected; (c) the Torch Trigger 1 gas control is pressed; and (d) the nozzle tip is touching the part.

IMPORTANT

To test interlocks and view External A and B interlock state or to perform torch diagnostics, users may: (1) use Front Panel Setup Mode (refer to Table 25 [▶97] Interlock Groups) or (2) webpage Welder Status pane.

▼ Figure 24. Door Interlock Closed - Safety Interlock is Satisfied



3. Have someone (other than the **OptX** device operator) now open the interlocked door while the operator is pressing Trigger 1 (gas control) and touching the nozzle to the part. If the door switches were installed correctly, the external safety interlocks will open. Confirm that the Interlock LED indicator on the front panel is turned OFF. Release the trigger 1 control and lift nozzle from part. Close the door again.

Note: The external safety interlocks have two redundant loops. If there is ever a mismatch (one loop opens while the other remains closed), the Error LED Indicator will illuminate and the error code Er13 will display. To clear this error both interlocks loops must first be opened and then closed again to continue.

4. Clear any errors. Open the interlocked door. Operator should press the Trigger 1 gas control on the Torch and touch the nozzle to the part. Confirm that the Interlock LED indicator is OFF. It should never turn ON under this condition since the external interlocks cannot be satisfied while the door is open.
5. Closing the door resets the interlocks. The **OptX** device is ready to operate.

! DANGER



Operating welder if door interlocks are not functional

Personnel entering the Laser Controlled Area without PPE can be exposed to invisible Class 4 laser radiation from reflected or scattered laser light. Permanent and severe eye damage, vision impairment and/or skin burns can occur.

- If defective, repair and/or replace interlock switches or wiring.
- Redo the test procedure above to confirm the interlocks are functional.

5.9 System Startup

⚠ WARNING



- All electrical connections must be connected prior to applying power to the unit.
- Where applicable, all connections must be secured with screws to ensure proper functionality.

⚠ WARNING



- Ensure you wear all PPE gear while operating this product. These include specified laser safety eyewear, welding helmet with face shield, heat-resistant gloves, clothes, apron.
- Make sure all power is removed from the laser when handling the delivery fiber cable. Minimum allowed bending radius is 50mm.

1. Ensure all connections required for successful installation have been completed.
 - Electrical Connection - section 5.7 [▶82].
 - Connect Work Sense Clamp Cable - section 5.3 [▶78].
 - Gas Supply Connections and Supply Turned ON - section 5.4 [▶79].
 - Torch Connections - section 5.5 [▶79].
2. Close external interlocks (12-pin connector: pins 1, 2 and 3, 4). If interlock is connected to door switches this means the door to the laser enclosure must be closed. Refer to section 5.6.1 [▶80] (pinout information) and 5.8 [▶84] (setup and testing of door interlocks).
3. Ensure the red E-Stop button, that is located on the front panel of the device, is released. If it is not, turn the button clockwise to release. Refer to section 7.1.8 [▶104].

IMPORTANT

When starting the laser device from an OFF state:

Even if you turn the key in the keyswitch to the (1) ON position, the laser device will not turn on if the E-Stop button is triggered (pressed).

- The E-Stop must first be released.

4. Turn load switch on the rear panel to the 1 (ON) position.
5. Turn the keyswitch clockwise to the 1 (ON) position.
6. All LED indicators and Displays will light ON for 3 seconds. Wait for the device controller CPU to fully boot up (takes approximately 7 seconds).
7. When the **OptX** device is turned ON for the very first time, the system boots up into a "locked" state. A 4-digit activation code is required to activate the unit for use. Refer to section 2.10 [▶59] for instructions on how to proceed. If unit was previously unlocked skip to next step.

IMPORTANT

Device IP address setting

- The IP address of the device is only shown when the unit first turns ON after the AC line cord is plugged into an outlet. The IP address of the device will show sequentially in the Wobble Frequency 3 digit display (e.g. 10 0 0 20 for factory default IP Address 10.0.0.20). See Figure 25 [▶ 91].
- **TIP:** If the IP address was changed and the user does not remember what it changed to, an easy way to recover it is to turn unit OFF (key to OFF position) and unplug the unit from AC power. The next time unit is plugged in and turned ON it will flash the IP address again.

▼ Figure 25. IP Address will Flash when Unit is First Turned On



8. Once the unit is powered ON and unlocked:
 - **Program Number Display:** shows the last, previously used program number that was used prior to shutting down the unit.
 - **Laser Power Display:** will show the power (in W) according to the setting for the selected program number.
 - **Wobble Frequency Display:** shows the number according to the setting for the selected program number.
 - **Wobble Length Display:** shows the number according to the setting for the selected program number.
 - **Guide Beam:** Note that the red guide beam will be OFF until the external interlocks are satisfied.

The laser welder is now ready for operation. Now that unit is powered ON, user should test the functionality of the door interlocks. Refer to section 5.8.3 [▶ 88].

IMPORTANT

If the handheld welding system is not going to be used and will be idle for some time, it is recommended to shutdown the weld unit (refer to section 5.10 [▶ 91]).

5.10 System Shutdown

To turn off the laser welder, the user must first disable emission after welding is completed:

1. Release Trigger 2 torch control switch. This will stop emission.
2. Release Trigger 1 torch control switch. This will stop the gas flow. The gas will continue to flow for an additional 1 second (default).

IMPORTANT

The pre and post gas flow time setting is settable via the webpage interface. These settings are configurable up to a maximum of 10 seconds.

3. Turn the keyswitch to 0 (OFF) position.
 - Remove the key from the switch and secure the key to prevent unauthorized use.

IMPORTANT

Turning keyswitch to 0 (OFF) position turns off the main DC power supply. The front panel displays and indicators are turned off. The laser cannot be turned on without the key inserted and turned to 1 (ON).

4. Shut off the gas supply.
5. Turn the load switch on the rear panel to 0 (OFF) position.

6 Operating Front Panel Controls

6.1 Rotary Control Knobs

There are 3 rotary control knobs on the front panel.

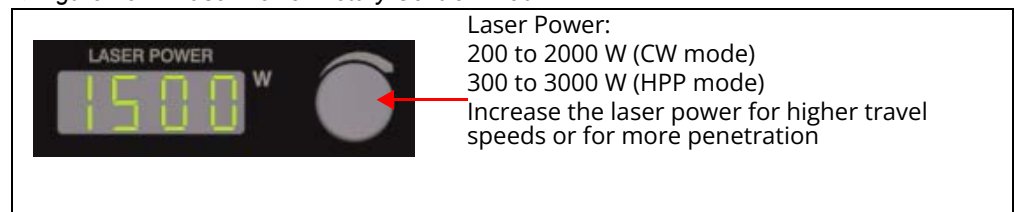
- **Laser Power** - refer to section 6.1.1 [▶93].
- **Wobble Frequency** - refer to section 6.1.2 [▶93].
- **Wobble Length** - refer to section 6.1.3 [▶94].

6.1.1 Laser Power Rotary Control Knob

This control knob allows operators to increase (clockwise) or decrease (counter-clockwise) the laser power that will be used for welding up to the maximum allowable power as specified in the *PRODUCT SPECIFICATION* document for the device.

- The knob speed allows to increase/decrease the value faster or slower.
- Fast rotation of the knob increments power by 100W intervals. Slow rotation of the knob increments the power by 10W increments.
- If the program display starts to blink it indicates that one or more parameters have changed compared to the saved settings for that program. You are no longer using the preset settings (or settings from user created program).
- If the power required for the application is less than 10% of the total laser power consider using pulsed mode - see section 8.2.3 [▶120] or 8.2.6 [▶122].

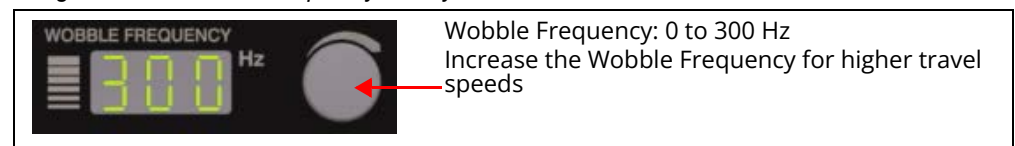
▼ Figure 26. Laser Power Rotary Control Knob



6.1.2 Wobble Frequency Rotary Control Knob

This control knob allows operators to increase (clockwise) or decrease (counter-clockwise) the Wobble Frequency that will be used for welding up to the allowable limit of the current mode.

▼ Figure 27. Wobble Frequency Rotary Control Knob



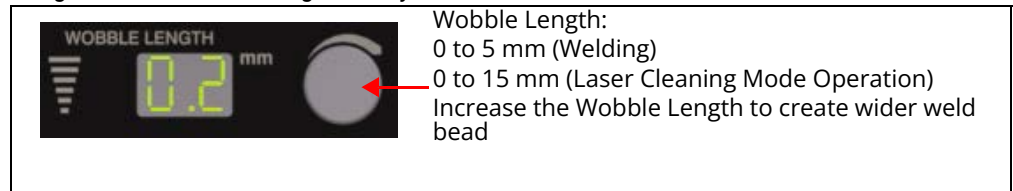
- The knob speed allows to increase/decrease the value faster or slower.
- Fast rotation of the knob increments the frequency by 10 Hz increments. Slow rotation of the knob increments the frequency by 1 Hz increments. The frequency setting can range anywhere from 0 up to 300 Hz.

- If the program display starts to blink it indicates that one or more parameters have changed compared to the saved settings for that program. You are no longer using the preset settings (or settings from user created program).
- If setting is at the low limit of 0 Hz this will turn the Beam Wobble OFF on the handheld torch.

6.1.3 Wobble Length Rotary Control Knob

This control knob allows operators to increase (clockwise) or decrease (counter-clockwise) the Wobble Length that will be used for welding up to the maximum allowable by current mode.

▼ Figure 28. Wobble Length Rotary Control Knob

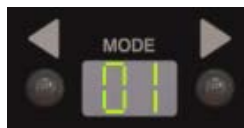


- The knob speed allows to increase/decrease the value faster or slower.
- Fast rotation of the knob increments the length by 1 mm increments. Slow rotation of the knob increments the frequency by 0.1 mm increments. The length setting can range anywhere from 0 up to 5.0 mm (or 0 - 15 mm for models operating in laser cleaning mode).
- If the program display starts to blink it indicates that one or more parameters have changed compared to the saved settings for that program. You are no longer using the preset settings (or settings from user created program).
- If the setting is at the low limit of 0 mm. This will turn the Beam Wobble OFF on the handheld torch.

6.2 Program Mode Weld Program Selection Buttons

Pushing the program mode selection buttons will increase or decrease the number in the Program display by increment 1. As each new weld program is selected, the Laser Power, Wobble Frequency, and Wobble Length displays will change to whatever setting value is programmed for that selected weld program.

▼ Figure 29. Program Mode Weld Program Selection



- There are two Program Mode Types: User and Preset.
- Users are allowed to create up to 26 User Mode recipes that are numbered 0 through 25. These recipes can be created either from the front panel control knobs or through the web interface. The user sets the Laser Power, Wobble Frequency and Length manually by using the rotary knobs on the front panel. When optimum settings are found, the recipe parameters are then saved under the selected program number. Refer to Table 24 [▶ 95].

- Preset Programs are pre-programmed parameters from the factory. The program identification number will be a letter followed by a number. (e.g. A0, A1, A2, C0, C1, C2, etc).
- The Preset Program letter options can be: A, C, E, F, H, J, L, P, U, and Y.

▼ Table 24. Program Mode Button Functions

Mode Button Functions	Description
Select Weld Program	Pushing the Program Mode Up Button (right arrow) will increase the Program Number by 1. Once it reaches 25 it will start back at 0, 1, 2, etc. Pushing the Program Mode Down Button (left arrow) will decrease the program Number by 1. Once it reaches 0 then it will go back to 25, 24, 23, etc. To jump between program modes (User 0 to Preset A, C, E etc), press and hold the Up Button for 2 seconds (or Down Button if decreasing). Once in the Preset Mode, push the Up or Down button once to increment through the recipes for that Preset mode (e.g. A0, A1, A2, etc).
Save Weld Program	For the selected program number, it will overwrite the values according to the present values displayed for Laser Power, Wobble Frequency and Wobble Length. To save weld program that was created: 1. Press and hold <u>both</u> the Mode Up and Down buttons simultaneously for 3 seconds. 2. Once the display stops blinking it is confirmation for the user that the program was saved
Reset Single Existing Weld Program	This will reset the selected program back to the factory default. 1. Press and hold <u>both</u> the Mode Up and Down buttons simultaneously for 6 seconds. 2. Once the display starts blinking faster it is reset.
Reset All Program Recipes	This will restore all program recipes back to the factory default. This function can also be done from the web page interface. 1. Press and hold <u>both</u> the Mode Up and Down buttons simultaneously for greater than 15 seconds. 2. Once the display starts blinking fast it is factory reset.

6.3 Device Front Panel Setup Mode

Setting the program mode to **Y0** (refer to Process Mode Chart that came with the device) puts the welder device into “Front Panel Setup Mode”.

This allows a user to set eight global device parameters using the front panel control knobs instead of the welder web page and therefore does not require a PC connected to the welder device.

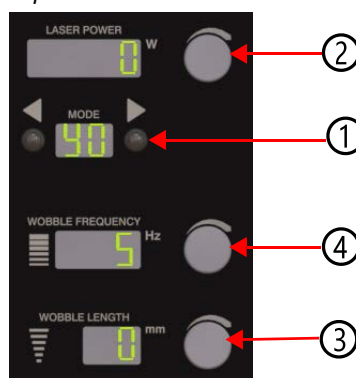
It allows a user to view welder status information, such as warnings and interlock states, on the front panel display instead of the welder web page. This is especially useful when testing interlocks or performing other troubleshooting tasks.

The Wobble Length rotary knob is used to select specific code numbers. The Wobble Frequency rotary knob is used to set parameter values (only for settable code numbers 0 to 5 and 14 to 15).

Note that if the code selected is read-only, the Wobble Frequency rotary knob and Laser Power rotary knob will be disabled. For settable parameters only the Laser Power rotary knob is disabled.

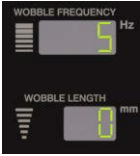
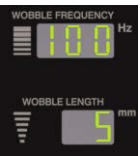
Refer to Table 25 [▶97] for information on each setup state code number.

▼ Figure 30. Front Panel Setup Mode Control



Item	Description
1	Use Mode buttons to set program mode “Y0”.
2	Laser Power rotary knob is disabled. Display will show “0”
3	Turn Wobble Length rotary knob to set Code #.
4	For Codes 0-5 and 14-15: Turn Wobble Frequency rotary knob to desired value. To save new value, save Y0 program mode. For Codes 6-13: Display will show parameter value. Knob is disabled.

▼ Table 25. Y0 Setup State Program Mode

Code #	Parameter	Front Panel Displays	Explanation User Must First Set Program Mode to Y0
0	Wobble Offset  Refer to section 9.10 [▶145].		Sets wobble offset (to center output beam when using wire feeder). 1. Turn Wobble Length knob to Code 0. 2. Turn Wobble Frequency knob to set offset +/- 3 mm. The value displayed is the offset multiplied by 10. Setting 5 is 0.5 mm offset. Setting 10 is equivalent to 1.0 mm offset. Setting -5 is equivalent to -0.5 mm. 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.
1	Purge   Refer to section 9.4 [▶132].		Sets gas purge enabled/disabled. 1. Turn Wobble Length knob to Code 1. 2. Turn Wobble Frequency knob to enable/disable. 0= Purge Disabled and 1= Purge Enabled 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.
2	Pre-Flow Gas Time Gas Pre-Flow: 2 [s] Refer to section 9.4 [▶132].		Sets pre-flow gas time (in s). 1. Turn Wobble Length knob to Code 2. 2. Turn Wobble Frequency knob to set time 0.1 - 10 s. 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.
3	Post-Flow GasTime Gas Post-Flow: 2 [s] Refer to section 9.4 [▶132].		Sets gas post-flow time (in s). 1. Turn Wobble Length knob to Code 3. 2. Turn Wobble Frequency knob to set time 0.1 - 10 s. 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.
4	Ramp Up Scale  Refer to section 9.10 [▶145].		Sets the ramp up scale. 1. Turn Wobble Length knob to Code 4. 2. Turn Wobble Frequency knob to set scale 10 - 200%. 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.
5	Ramp Down Scale  Refer to section 9.10 [▶145].		Sets the ramp down scale. 1. Turn Wobble Length knob to Code 5. 2. Turn Wobble Frequency knob to set scale 10 - 200%. 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.
6	Laser Temperature Temperature: 22.4 [°C] See Table 31 [▶133].		Displays the laser temperature reading (in °C). 1. Turn Wobble Length knob to Code 6. 2. Wobble Frequency display shows the laser temperature reading. In this example it is 22.4 °C.

▼ Table 25. Y0 Setup State Program Mode (Continued)

Code #	Parameter	Front Panel Displays	Explanation User Must First Set Program Mode to Y0
7	Warning Group 1  See Table 31 ▶133 .	 ¹ See NOTE	Displays first group of 3 Warning states. 1. Turn Wobble Length knob to Code 7. 2. Wobble Frequency display shows warning state. In this example, ".0.0" or "0.0.0" (depending on display revision) indicates that there are no warnings. 0= NO WARNING and 1= WARNING Result format, left to right, is specified below. 3rd Digit . 2nd Digit . 1st Digit (Guide Warning).(Temperature).(No Gas)
8	Warning Group 2  See Table 31 ▶133 .	 ¹ See NOTE	Displays second group of 3 Warning states. 1. Turn Wobble Length knob to Code 8. 2. Wobble Frequency display shows warning state. In this example, ".0.0" or "0.0.0" (depending on display revision) indicates that there are no warnings. 0= NO WARNING and 1= WARNING Result format, left to right, is specified below. 3rd Digit . 2nd Digit . 1st Digit (Reserved).(Maintenance).(Ambient Light)
9	Interlock Group 1  See Table 31 ▶133 .	 ¹ See NOTE	Displays first group of 3 Interlock states. This is primarily used to test or troubleshoot the torch. 1. Turn Wobble Length knob to Code 9. 2. Wobble Frequency display shows interlock state. In this example, ".0.0" or "0.0.0" (depending on display revision) means that all 3 are NOT ACTIVE. 0= NOT ACTIVE and 1= ACTIVE Result format, left to right, is specified below. 3rd Digit . 2nd Digit . 1st Digit (Trigger 2 OK).(Trigger 1 OK).(Nozzle OK) Torch Diagnostic Examples: When operator presses Trigger 1 (or 2) switch on torch - it turns to 1. When operator releases Trigger 1 (or 2) switch - it turns to 0. Touch nozzle to workpiece - it turns to 1. Lift nozzle from workpiece - it turns to 0.

▼ Table 25. Y0 Setup State Program Mode (Continued)

Code #	Parameter	Front Panel Displays	Explanation User Must First Set Program Mode to Y0
10	Interlock Group 2  See Table 31 [▶133].	 1 See NOTE	Displays second group of 3 Interlock states. 1. Turn Wobble Length knob to Code 10. 2. Wobble Frequency display shows interlock state. In this example, 1.1.1 means that all 3 interlocks are OK. 0= NOT OK and 1= OK (interlock satisfied) Result format, left to right, is specified below. 3rd Digit . 2nd Digit . 1st Digit (Fiber Interlocks OK).(External A OK).(External B OK) Interlock Examples: 1 - Fiber cable is properly connected to torch. 1 - Door to laser controlled area is closed. External A/B interlocks are for door interlocks to laser controlled area, as an example.
11	Hours On H: 245 See Table 31 [▶133].		Displays the device total ON hours (1 count for every 10 hours). 1. Turn Wobble Length knob to Code 11. 2. Wobble Frequency display shows the total number of hours device was ON. In this example it's 25 counts or 250 hours.
12	Emission ON Hours E: 8 Hours See Table 31 [▶133].		Displays the device total Emission ON hours. 1. Turn Wobble Length knob to Code 12. 2. Wobble Frequency display shows number of hours laser emission was ON. In this example it's 8 Emission ON hours.
13	Firmware Revision Application: 2.0.3.150330 Refer to section 9.6 [▶139].		Displays the firmware revision number. 1. Turn Wobble Length knob to Code 13. 2. Wobble Frequency display shows device revision number. In this example the revision is 2.0.3.
14	Purge Time Purge Time: 60 [s] Refer to section 9.10 [▶145].		Sets the Purge Time (seconds). 1. Turn Wobble Length knob to Code 14. 2. Turn Wobble Frequency knob to set time 0 to 998 s (default is 60 s). Setting the purge time to 999 will keep purge gas on infinitely (replicating legacy operation). 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.
15	Maintenance Time Refer to section 9.10 [▶145].		Set the maintenance time interval (in emission on hours). This feature tracks the number of hours the emission has been on since it was last cleared, and generates a warning when the number of hours exceeds the threshold set here. 1. Turn Wobble Length knob to Code 15. 2. Turn Wobble Frequency knob clockwise to set the maintenance time interval emission on hours. 3. Press and hold both the Mode Up and Down buttons simultaneously for 3 seconds to save setting.

▼ Table 25. Y0 Setup State Program Mode (Continued)

Code #	Parameter	Front Panel Displays	Explanation User Must First Set Program Mode to Y0
16	Maintenance Reset Refer to section 9.10 [▶145].		This will clear the maintenance time warning and reset the timer for the maintenance interval. 1. Turn Wobble Length knob to Code 16. 2. Turn Wobble Frequency knob clockwise to toggle the setting, which will reset the maintenance warning timer.

¹. **NOTE:** Digit on left may be blank on some models, depends on revision of display. In this case, Blank = 0.

7 Operating Laser Welder

7.1 Safety Precautions

7.1.1 Fiber Interlock

The optical interlock is connected to the optical fiber connector (LC-8) and provides a method to interlock the fiber connector to external optical components (such as the handheld torch). The laser welder monitors this signal and shuts down or prevents emission start if the optical connector is not properly terminated at the torch.

The weld unit provides an interlock signal output based on the state of the interlock wires included in the fiber cable between the laser device and the handheld torch. If the fiber cable connection to the torch is unplugged or broken, the two interlock relays will open.

WARNING



Do not use torch from other suppliers

Connecting fiber or electrical connector to torch from other suppliers will cause safety functions to not work as intended. This can also damage the device.

- Only connect the fiber to a Miller approved and supplied torch.
- Do not plug in other devices to the laser welder head connections on the rear panel other than the cable and torch provided.

7.1.2 External Interlocks

The device includes an Interlock Safety Circuit that uses a dual-channel system with monitored output and manual reset. When you open the Interlock, the safety circuit opens and the power to the laser diodes is removed.

Close the dual-channel interlock (on 12-pin connector: pin-1 is connected with pin-2 and pin-3 is connected with pin-4). Otherwise, the internal main power supply is switched off and laser emission cannot be turned on.

IMPORTANT

Once any one of the pairs of the contacts mentioned above is opened, you cannot switch the laser's power supply on until the second pair is opened and then both pairs are closed.

These interlocks must be wired to the operator's external safety measures. Opening either channel will result in the clearing of the safety latches. The status of external interlock A and B are monitored for consistency by the device.

The external interlock pins are intended to satisfy the Remote Interlock Connector requirement as defined by EN 60825-1 (6.4). If the connections between pins 1,2 and 3,4 are breached by a door interlock or other means, laser emission will be prevented. Safety characteristics according to EN ISO 13849-1:2015; Performance Level PL d, category 3.

7.1.3 Torch Nozzle and Work Sense Clamp Interlock

This safety loop ensures the laser only fires when the torch nozzle is electrically connected (touching) to the workpiece. The operator must clamp the workpiece to the M8 shank on the rear panel of the unit. Whenever the nozzle of the torch touches the workpiece the nozzle interlock loop will be closed and satisfied. If the operator lifts the nozzle from the workpiece during welding, this interlock loop opens and the laser will shut off automatically.

7.1.4 Torch Two Level Trigger

Built into the torch is a trigger switch with two discrete channels. Trigger 1 is an interlock loop that closes when pressed. Trigger 2 is a start button and an additional interlock loop that will close when pressed.

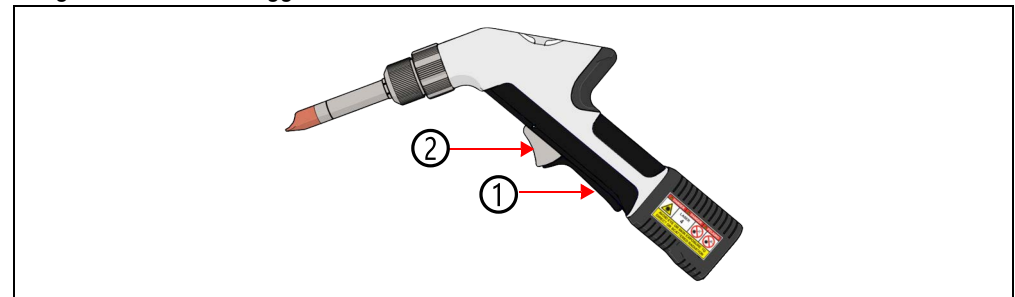
- **Pressing Trigger 1** on the torch will turn on the shield gas. Whenever Trigger 1 is released the shield gas will stay on for an additional 1 second (post-flow gas time is configurable up to a maximum of 10 seconds) before turning off the gas flow.

To turn on the laser emission using the Trigger 2 switch, the operator must continue to hold the Trigger 1 switch closed during welding. Releasing Trigger 1 while Trigger 2 is pressed will cause an error that stops the laser emission.



- **Pressing Trigger 2** on the torch acts as a start button for the laser. The laser will fire provided all safety conditions are satisfied and the shield gas has been detected for at least 1 second prior (pre-flow gas time is configurable up to maximum of 10 seconds). To weld, the operator must continue to hold Trigger 2 switch closed for laser emission to stay on. Releasing Trigger 2 will stop laser emission. Trigger 2 can be released without releasing Trigger 1.

▼ Figure 31. Torch Trigger Controls



Item	Designation	Item	Designation
1	Trigger 1 - Press and Hold to Start Gas Flow	2	Trigger 2 - Press and Hold to Start Laser Emission

7.1.5 Overheating Control

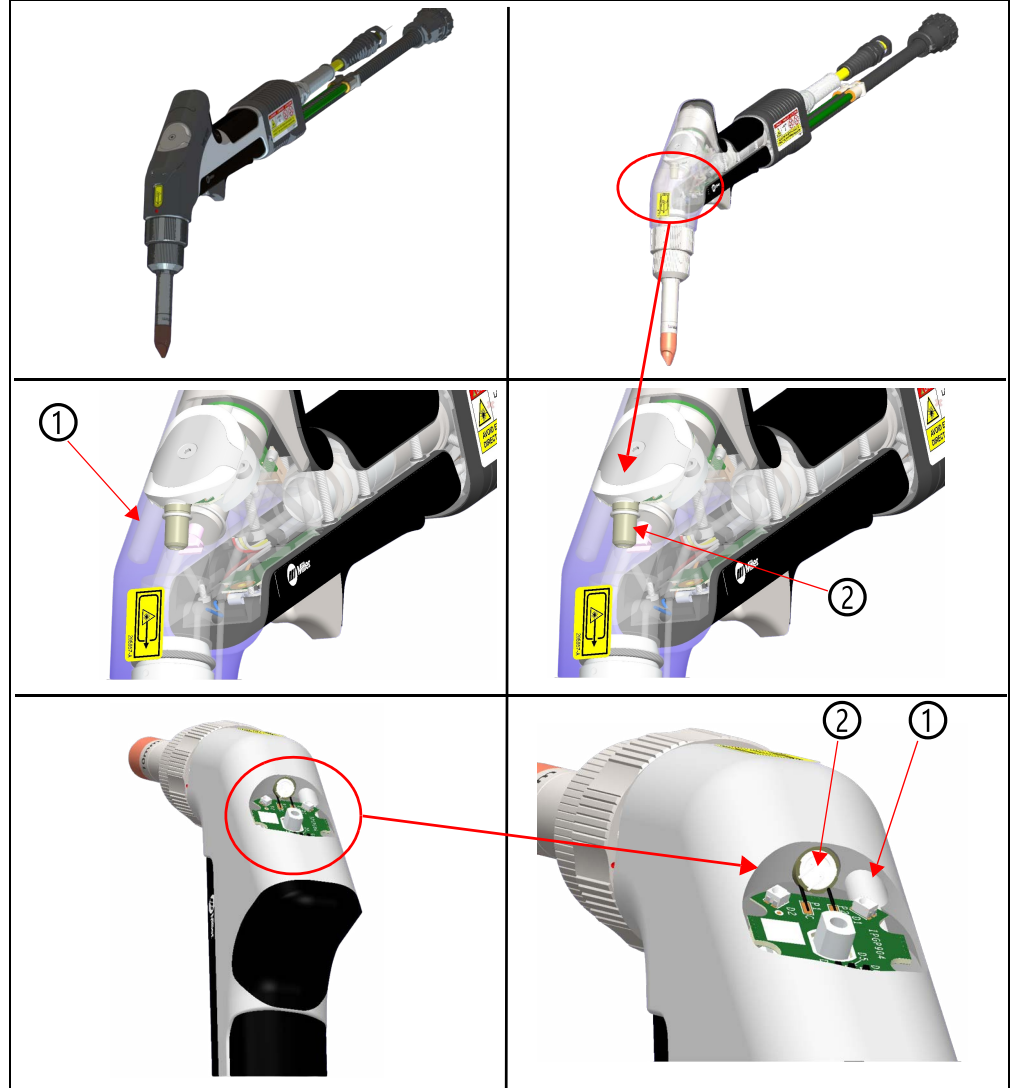
Device thermal sensor

A thermal sensor monitors the air-cooled laser heat sink temperature. If the temperature exceeds limits, the laser will not operate. For more information, refer to code Er03 in Table 35 [▶ 151].

Torch thermal fuse

A thermal fuse is built into the torch which will shut down the laser through the fiber interlock circuit if the torch exceeds the temperature limit for any reason, including damaged optics. This is a non-resettable, one-time-only protection device. The location of the thermal fuse is indicated in Figure 32 [▶ 103] (item 1).

▼ Figure 32. Torch Thermal Fuse and Plasma Sensor



Item	Designation	Item	Designation
1	Thermal Fuse	2	Plasma Sensor

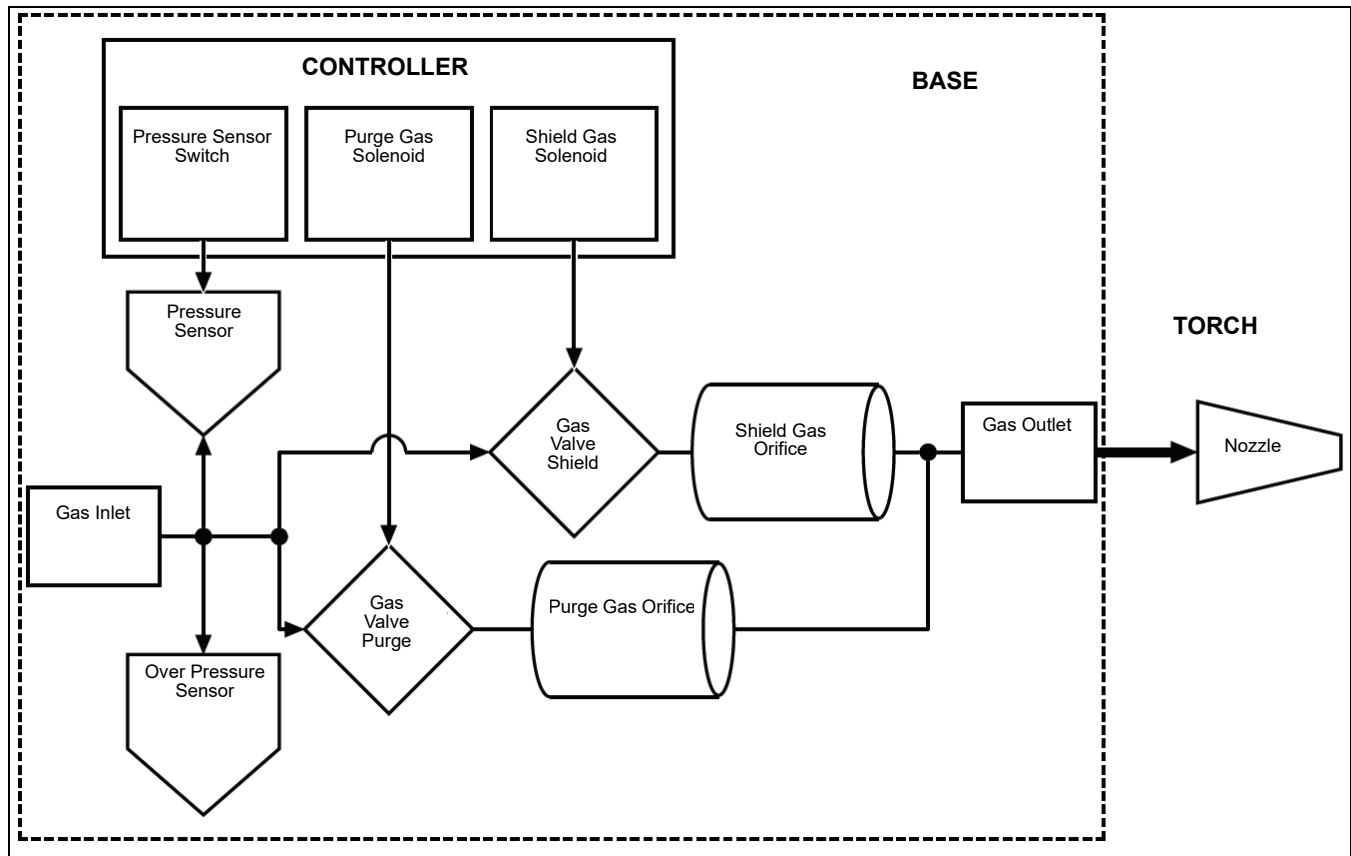
7.1.6 Plasma Detection

The handheld torch includes a photo sensor to monitor plasma (the bright visible light created during welding). If there is not sufficient plasma light created after the start of a weld, the laser will automatically turn emission off. The location of the Plasma Sensor is indicated in Figure 32 [▶ 103] (item 2).

7.1.7 Gas Pressure Monitoring

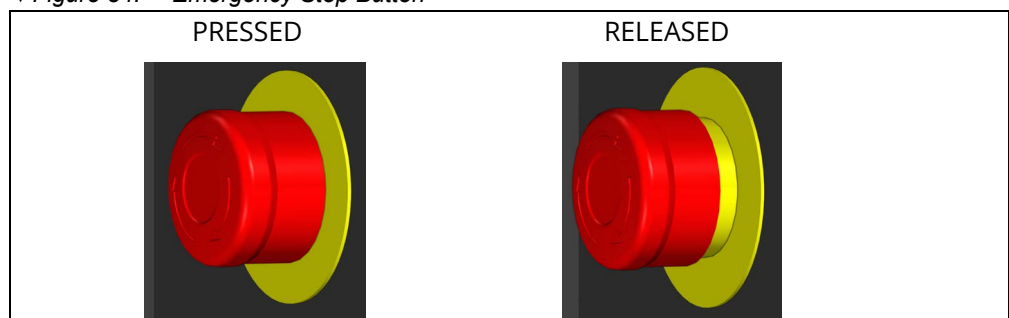
The availability of shielding gas is monitored by requiring a minimum gas pressure that activates a sensor. When there is less than approximately 10 psi (0.7 bar) pressure present, the laser will not turn on. The green gas LED indicator on the front panel will not be lit when there is insufficient pressure. If gas pressure exceeds maximum pressure, a relief valve opens to prevent damage to the gas valves. The pressure present sensor is located inside the base of the device. Refer to block diagram drawing in Figure 33 [▶ 104].

▼ Figure 33. Gas Pressure Monitoring Block Diagram



7.1.8 Emergency Stop Button (E-Stop)

▼ Figure 34. Emergency Stop Button



In case of an emergency, press the red E-Stop button on the front panel.

When the E-Stop Button is triggered (pressed) the following occurs:

- The E-Stop function opens an interlock in the safety circuitry of the device.
- The laser will turn off (laser emission will stop if it was on).
- The device controller CPU is held in reset.
- The pins 5-6, 7-8 on the 12-pin I/O connector are set OFF (refer to Table 20 [▶80]).
- The wire feeder will stop, if one was connected and being used.
- Front panel: All indicator lights and LED displays will be off. All control knobs and buttons are disabled.
- Ethernet is disabled (communication between the laser device and connected PC is lost.) Will not be able to access the webpage interface.

To release the E-Stop:

Turn the red E-Stop button clockwise in the direction indicated by the arrows on the front of the red button, as shown in figure above.

IMPORTANT

- ▶ **During System Startup:** When starting the system from an OFF state users should first check if the E-Stop button is pressed and release it. Even if you turn the key in the keyswitch to the (1) ON position, the laser device will not turn ON while the E-Stop button is triggered (pressed).
- ▶ **During Laser Operation:** If the E-Stop button is pressed while laser emission is ON (i.e. during welding), the laser radiation will turn OFF (stop). Laser emission cannot be turned on again until the button is released.

7.1.9 Warning and Status Lights

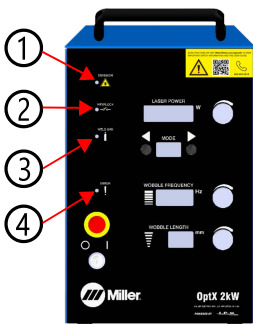
On top of the torch there are two status LED indicators:

1. Emission Status Indicator is lit:
 - ▶ **Red** - When laser emission is ON.
2. Interlock Status Indicator is lit:
 - ▶ **Solid Green** - When Trigger 1 control is pressed and no errors are present.
 - ▶ **Blinking Green** - Once all the interlocks are satisfied, the system is ready to fire. Operator can initiate laser emission by pressing Trigger 2 Control on the torch.

Torch status lights



Device status lights



The device front panel has four LED status indicators:

1. **Emission** - Status indicator is lit yellow when laser emission is ON.
2. **Interlock** - Status indicator is lit green when all safety interlock loops are satisfied. Once this indicator is lit it means that laser emission can be turned ON by pressing the Trigger 2 control on the torch, provided there are no alarms and gas delay time is met.
3. **Gas** - Status indicator is lit green when there is sufficient gas pressure coming into the device from gas supply.
4. **Error** - Status indicator is lit red when alarm occurs. Alarms will stop the welding process by shutting down laser emission.

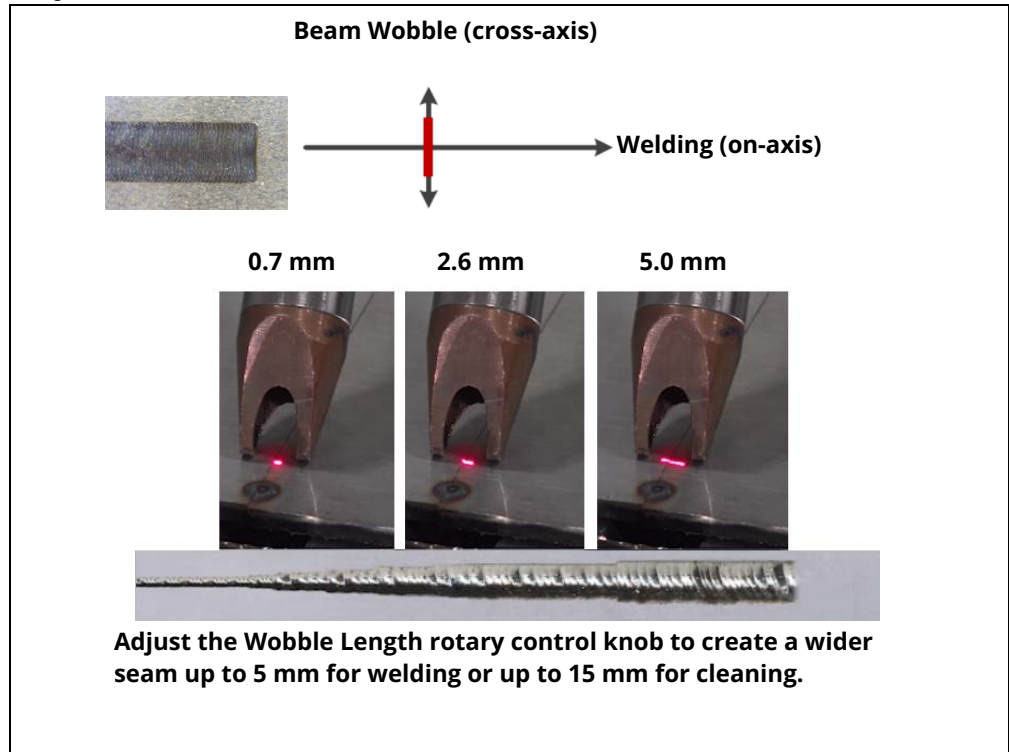
7.2 Integrated Beam Wobble Function

The **OptX** device's "beam wobble" functionality creates a wider weld seam which improves the quality and aesthetics of the weld joint. The integrated wobble device optics deflect the laser beam and sweep it linearly back and forth along the cross-axis relative to the on-axis welding direction motion. The Wobble Frequency and Wobble Length can be adjusted via the rotary control knobs on the front panel of the weld unit.

Since the IR laser beam is invisible, users may use the visible red guide laser beam to fine tune the frequency and length parameters for the wobble device. In the images below, adjusting the wobble length (up to 5 mm possible), will increase the width of the weld seam as shown in Figure 35 [▶ 106].

When the selected program is configured to use the CLEAN laser mode, the wobble length can be adjusted up to 15 mm. To use the 15 mm wobble length (for cleaning) the user must first install the optimum cleaning nozzle on the torch. When using a different laser mode, other than cleaning mode, the wobble length will only be adjustable up to 5 mm.

▼ Figure 35. Beam Wobble Function



7.3 Torch Nozzle Tip and Tube

Personnel Qualifications: Advanced Operating Personnel (see section 1.4 [▶18]).

7.3.1 Nozzle Tip Types

There are five types of nozzle tips available for welding (Figure [▶108]). Proper selection of the nozzle tip is required for safety and to also achieve the optimum welding results. Use chart (Table 26 [▶108]) to select the nozzle tip based on the type of weld joint (butt, corner, tee, lap or edge joints).

The information in the 2 point nozzle tip row is applicable for both 6 mm and 9 mm types.

WARNING



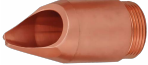
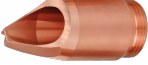
Improper nozzle tip selection

Improper nozzle tip selection increases the likelihood of unwanted and dangerous reflections, improper welding and the risk of injury. Refer to Table 26 [▶108].

When operating the system in CLEAN laser mode, there are 3 additional nozzles available. Refer to Table 26 [▶108].

Compared to other models, the cleaning nozzles are sized differently due to optical differences within the torch. Therefore, users with multiple model types should not mix and match the cleaning nozzles. **OptX** models must use the **OptX** cleaning nozzles.

▼ Table 26. Welding and Cleaning Nozzle Selection Chart

WELDING AND CLEANING NOZZLE SELECTION					
	Butt Joint	Corner Joint	Tee Joint	Lap Joint	Edge Joint
Welding					
					
Cleaning					
WELDING NOZZLE KIT (#301832)			CLEANING NOZZLE KIT (#301833)		
Nozzle, OptX, Welding, Conical #301811			Nozzle, OptX, Cleaning, Outside Corner #301819		
Nozzle, OptX, Welding, 1-Point #301812			Nozzle, OptX, Cleaning, 1-Point #301820		
Nozzle, OptX, Welding, 2-Point 6mm #301813			Nozzle, OptX, Cleaning, 2-Point #301821		
Nozzle, OptX, Welding, 2-Point 9mm #301814					
Nozzle, OptX, Welding, Wire Feed #301815					

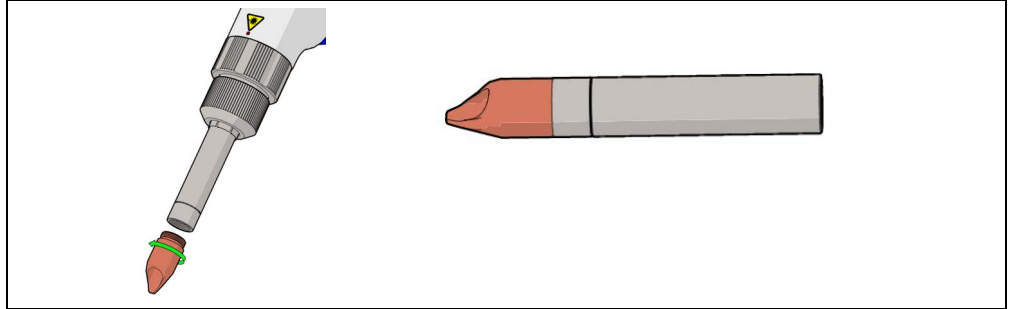
7.3.2 Installing Nozzle Tip for Welding

IMPORTANT

Prior to changing the nozzle tip, shutdown the unit using the keyswitch (refer to section 5.10 [▶91]).

The following applies for all models. The nozzle tip will thread onto the torch's extension tube. It is important to adjust the nozzle orientation (see next section) so that the tip is not rotated. Do not operate the device with the nozzle rotated.

▼Figure 36. Nozzle Tip Installation



7.3.3 Changing Nozzle and Adjusting Rotation

IMPORTANT

Prior to adjusting or replacing the nozzle tube, shutdown the unit using the keyswitch (refer to section 5.10 [▶91]).

1. First loosen the collet chuck. See first row pictures in Table 27 [▶110].
2. When switching between welding and cleaning nozzles, remove the nozzle from the torch and replace with the nozzle type you want to use. Make sure you insert the nozzle as far as it will go into the torch. See second row pictures in Table 27 [▶110].

NOTICE

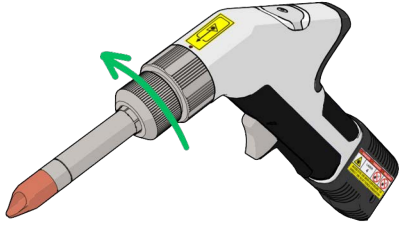
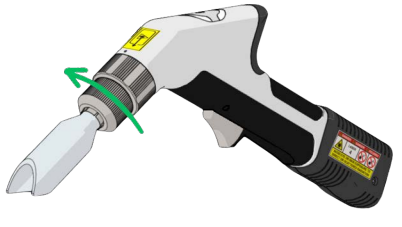
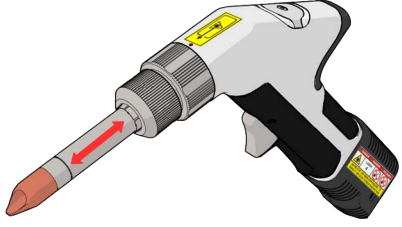
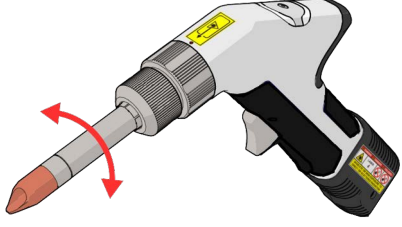
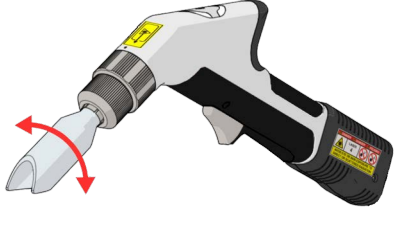
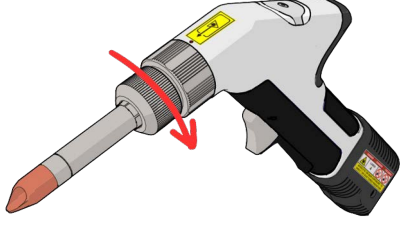
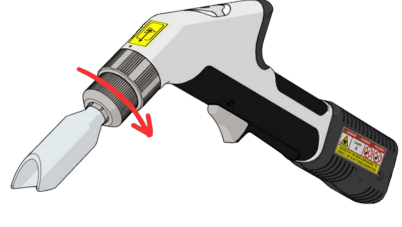
Uncontrolled reflection of laser class 4 radiation in case of wrong nozzle tip orientation

Operating the device with the nozzle rotated, can cause the beam to reflect onto a part of the nozzle tip instead, possibly damaging the tip or causing a undesired and uncontrolled reflection or scattering of the laser light.

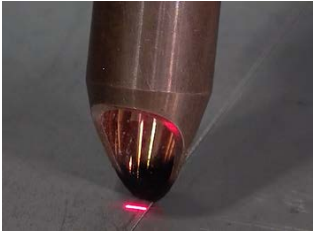
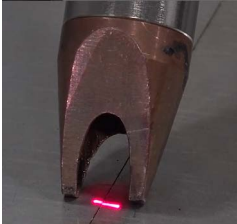
- After the operator changes welding tips, he/she needs to check that the nozzle tip is not rotated.
- Example pictures showing correct orientation of the welding nozzle tips and cleaning nozzles are shown in Table 28 [▶111].

3. Check the orientation of the nozzle and correct the rotation. See third row pictures in Table 27 [▶110]. For example pictures that show correct orientation, refer to Table 28 [▶111].
4. Once the nozzle orientation is corrected, tighten the collet chuck to lock the nozzle position. Only hand tighten. See fourth row pictures in Table 27 [▶110].

▼ Table 27. Changing and/or Adjusting the Torch Nozzle

Welding Nozzle Tip	Cleaning Nozzle
1. Loosen collet chuck to unlock nozzle. 	1. Loosen collet chuck to unlock nozzle. 
2. Pull out the nozzle and insert the new nozzle. 	2. Pull out the nozzle and insert the new nozzle. 
3. Correct the nozzle rotation so tip is not rotated. 	3. Correct the nozzle rotation so tip is not rotated. 
4. Tighten collet chuck to lock nozzle position. 	4. Tighten collet chuck to lock nozzle position. 

▼ Table 28. Examples of Correct Nozzle Placement and Orientation

Welding Nozzle Tips	Cleaning Nozzles
1-point welding nozzle tip positioned over the seam is shown here. 	1-point cleaning nozzle is shown here. Red arrow indicates cleaning direction on-axis. 
2-point welding nozzle tip positioned across the seam is shown here. 	2-point cleaning nozzle is shown here. Red arrow indicates cleaning direction on-axis. 

7.4 Quick Start Welding Using Preset Programs

Personnel Qualifications: Operating Personnel (refer to section 1.4 [▶18]).

⚠ DANGER



Eye hazards during OptX device operation

Risk of permanent eye damage and vision impairment from invisible reflected and scattered Class 4 laser radiation. Also risk of eye damage as a result of exposure to UV light, welding bright light, heat and sparks produced during the material processing.

- ▶ All persons in the Laser Controlled Area must wear the combination of (1) the specified laser safety eyewear, and (2) welding helmet with appropriate filters (for UV and visible radiation) and face shield will offer the best protection during laser welding.
- ▶ A welding helmet can also protect the Operator from being injured due to hot spatter, metal particulates and sparks.

⚠ WARNING



Skin hazards during welding. Mandatory PPE required.

Risk of skin burns from laser radiation, sparks and hot parts.

- ▶ All persons in the Laser Controlled Area must take precautions to prevent skin damage by wearing protective clothing.
- ▶ Personal protective equipment includes: (1) welding helmet with appropriate filters and face shield over specified laser safety eyewear; (2) heat-resistant gloves, caps, suit, leather apron and other heat-resistant clothes.

1. Verify the door safety interlock circuit is working and lights the error indicator on the front panel of the device when the door is opened (external interlocks A or B open). Closing the door will clear the alarm. Refer to section 5.8.3 [▶88].
2. Select nozzle tip. Install tip on torch extension tube (section 7.3 [▶107]).
3. Select weld program from Quick Start Table (section 8.1 [▶119]). For this example we will choose preset program A2 for 2mm thickness stainless steel to be processed in CW laser mode.
4. Select the program (e.g. A2) using the unit's front panel buttons (section 6.2 [▶94]).
5. Secure parts to be welded. In laser welding it is desirable to secure the parts with minimum gap and closely touching wherever possible.

6. Ensure the Work Sense clamp is connected to either the parts, or the electrically conductive welding table on which the parts are placed.



7. Press Trigger 1 on the torch to turn on the shielding gas. Wait for a few seconds to clear the gas line.
8. Touch the nozzle tip to the part being welded. This closes the safety circuit and the laser is now ready to fire. Since the IR laser beam is invisible, use the red guide beam to position the nozzle correctly onto the part. The picture below shows the proper angle to hold the torch when positioning the nozzle onto the part being welded.



IMPORTANT

For **Seam Welding:**

- Laser welding is done with a pulling motion at constant as possible travel speed to provide an even weld depth. By adjusting the speed or power you can change the depth of the weld.
- Practice the motion before pressing Trigger 2. Do not break contact with the part. If the nozzle tip is lifted up off the part at any time, while Trigger 2 is pressed, the laser will automatically turn OFF.



9. Press Trigger 2 on the torch to start laser emission and initiate welding.

IMPORTANT

For **Tack Welding:**

- Press and hold Trigger 2 for 5 seconds until the laser power ramps down automatically. Release Trigger 2, move to next location and repeat steps 8 and 9.

IMPORTANT

For Wire Welding:

- When wire welding, the travel speed is determined by the feed rate of the wire feeder. Do not push or pull the welding head while welding. The wire feeder will push the welding head down the joint automatically. By adjusting the wire feeder speed or power you can change the depth of the weld.
 - Practice the motion before pressing Trigger 2. Do not break contact with the part. If the nozzle tip is lifted up off the part at any time, while Trigger 2 is pressed, the laser will automatically turn OFF.
-

IMPORTANT

- To further improve the process, operators may adjust some of the process settings by either increasing or decreasing the laser power, wobble frequency or length using the three rotary control knobs on the front panel.
 - When operators make changes to the default weld program settings, the parameter values on the front panel display will flash. The flashing indicates that the current setting does not match the programmed weld program setting.
-

7.5 Quick Start Cleaning Using Preset Programs

This section is only applicable when operating in laser cleaning mode.

Personnel Qualifications: Operating Personnel (refer to section 1.4 [▶18]).

⚠ DANGER



Eye hazards during OptX device operation

Risk of permanent eye damage and vision impairment from invisible reflected and scattered Class 4 laser radiation. Also risk of eye damage as a result of exposure to UV light, welding bright light, heat and sparks produced during the material processing.

- All persons in the Laser Controlled Area must wear the combination of (1) the specified laser safety eyewear, and (2) welding helmet with appropriate filters (for UV and visible radiation) and face shield will offer the best protection during laser welding.
- A welding helmet can also protect the Operator from being injured due to hot spatter, metal particulates and sparks.

⚠ WARNING



Skin hazards during welding. Mandatory PPE required.

Risk of skin burns from laser radiation, sparks and hot parts.

- All persons in the Laser Controlled Area must take precautions to prevent skin damage by wearing protective clothing.
- Personal protective equipment includes: (1) welding helmet with appropriate filters and face shield over specified laser safety eyewear; (2) heat-resistant gloves, caps, suit, leather apron and other heat-resistant clothes.

IMPORTANT

1. Verify the door safety interlock circuit is working and lights the error indicator on the front panel of the device when the door is opened (external interlocks A or B open). Closing the door will clear the alarm. Refer to section 5.8.3 [▶88].
2. Select cleaning nozzle. Install nozzle on torch (section 7.3 [▶107]).

- When operating the device in laser cleaning mode an adjustment up to a 15 mm beam wobble length is allowed.
- Note that it is possible to clean a part using the same nozzle tip that was used during welding. However, for this case the beam wobble length should always be set to a value of 5 mm or less.

NOTICE**Using incorrect nozzle results in torch damage**

Damage to torch if beam wobble length is set to value greater than 5 mm while using a welding nozzle tip.

- For cleaning width 5 to 15 mm, one of the cleaning nozzles MUST be installed on the torch.

3. Select cleaning program from the *Process Mode Chart* that came with the system (section 8.1 [▶119]). For this example we will choose preset program P1.

IMPORTANT

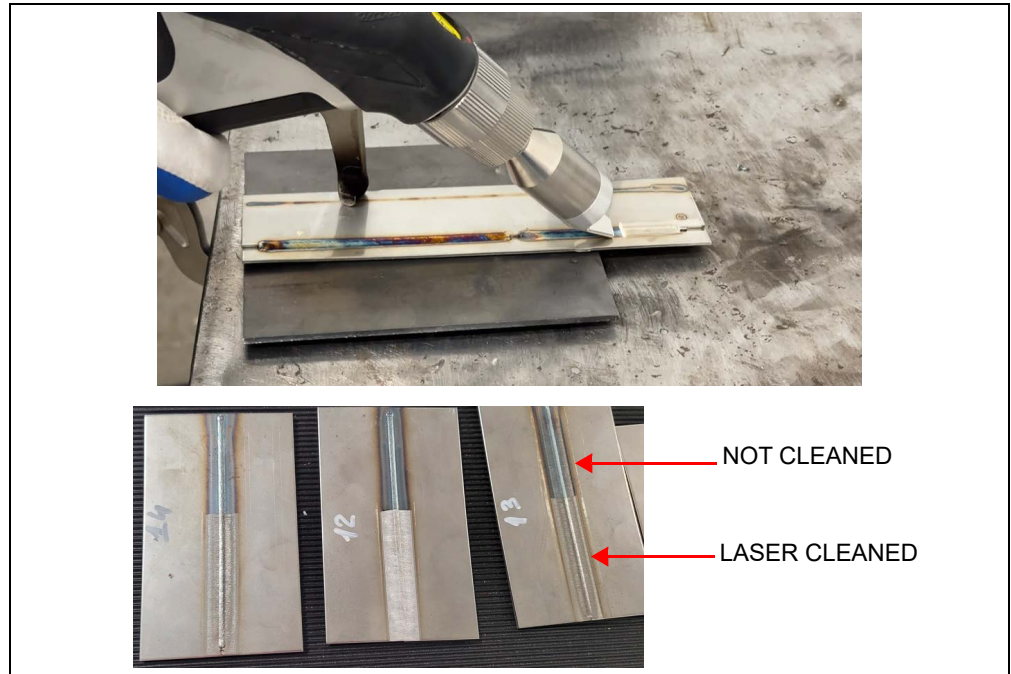
- There are preset cleaning programs for stainless steel, steel, galvanized steel and aluminum. For each material specified there will be a choice between a less aggressive or more aggressive cleaning program option.

4. Select the program (e.g. P1) using the unit's front panel buttons (section 6.2 [▶94]).
5. Secure parts to be cleaned.
6. Ensure the Work Sense clamp is connected to either the parts, or the electrically conductive welding table on which the parts are placed.



7. Press Trigger 1 on the torch to turn on the shielding gas. Wait for a few seconds to clear the gas line.
8. Touch the nozzle tip to the part being cleaned. This closes the safety circuit and the laser is now ready to fire. Since the IR laser beam is invisible, use the red guide beam to position the nozzle correctly onto the part. The picture below shows the proper angle to hold the torch when positioning the nozzle onto the part being cleaned.

▼ Figure 37. OptX System Operator Performing Laser Cleaning



IMPORTANT

For **Cleaning:**

- Laser cleaning is done with a pulling motion at constant as possible travel speed.
- Practice the motion before pressing Trigger 2. Do not break contact with the part. If the nozzle tip is lifted up off the part at any time, while Trigger 2 is pressed, the laser will automatically turn OFF.



IMPORTANT

9. Press Trigger 2 on the torch to start laser emission and initiate cleaning.

- To further improve the process, operators may adjust some of the process settings by either increasing or decreasing the laser power, wobble frequency or length using the three rotary control knobs on the front panel.
- When operators make changes to the default weld program settings, the parameter values on the front panel display will flash. The flashing indicates that the current setting does not match the programmed cleaning program setting.

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8 Weld Programs and Parameters

8.1 Quick Start Parameters Set

Select Preset program from Miller's *Process Mode Chart* to suit the welding application. For example, if welding 2 mm thickness stainless steel in CW mode, set program mode **A2** using the welder unit's front panel control buttons. To further optimize the welding process, the operator may use the three rotary control knobs to adjust those settings even further.

IMPORTANT

A laminated copy of the mode chart for your device is provided with the unit. If that sheet is lost, a copy of the mode chart may also be downloaded from the Miller Product Support webpage (refer to section B [▶ 169](#)).

8.2 Welding Mode Descriptions

There are seven types of laser welding modes.

- **CW** - Used for seam welding (see section 8.2.1 [▶ 119](#))
- **TACK** - Used for tack welding (see section 8.2.2 [▶ 120](#))
- **PULSED** - Used for thin joints and foils (see section 8.2.3 [▶ 120](#))
- **HPP** - Used for welding of reflective materials (see section 8.2.4 [▶ 121](#))
- **STITCH** - Used for stitch welding (see section 8.2.5 [▶ 121](#))
- **CLEAN** - Used to remove oils, rust, contaminants and coatings before welding, and remove soot, debris and discoloration after welding. (see section 8.2.6 [▶ 122](#))
- **ADV. STITCH** - Used for stitch welding. This mode allows users to select pulse wave shapes that were previously set up. (see section 8.2.7 [▶ 122](#))

8.2.1 CW Mode Parameters - Seam Welding

#	Parameter	Dimension	Min	Max
1	Laser Power ¹	W	0 / 200	2000
2	Wobble Frequency	Hz	0	300
3	Wobble Length	mm	0	5.0
4	Ramp Up Time	ms	0	2000
5	Ramp Down Time	ms	0	2000
6	Material Selection	Choose either Steel or Aluminum		

¹. The device will allow users to set a minimum power of 0 W. However, the minimum allowable power for laser processing is 200 W.

Above parameter settings need to be configured to operate in "CW" mode. The min and max allowable settings are specified.

Parameter definitions are specified in the glossary of terms in section 8.4 [▶ 125](#).

8.2.2 TACK Mode Parameters - Tack Welding

#	Parameter	Dimension	Min	Max
1	Laser Power ¹	W	0 / 200	2000
2	Wobble Frequency	Hz	0	300
3	Wobble Length	mm	0	5.0
4	Ramp Up Time	ms	0	2000
5	Tack Time	ms	0	4500
6	Ramp Down Time	ms	0	2000
7	Material Selection	Choose between Steel or Aluminum		

¹. The device will allow users to set a minimum power of 0 W. However, the minimum allowable power for laser processing is 200 W.

Above parameter settings need to be configured to operate in "TACK" mode. The min and max allowable settings are specified.

Parameter definitions are specified in the glossary of terms in section 8.4 [[▶125](#)].

8.2.3 Pulsed Mode Parameters - Thin Joints & Foils

#	Parameter	Dimension	Min	Max
1	Laser Power ¹	W	0 / 200	2000
2	Wobble Frequency	Hz	0	300
3	Wobble Length	mm	0	5.0
4	Pulse Frequency	Hz	2	1500
5	Pulse Duty Cycle	%	0	100
6	Waveform Program N ²	1	0	20
7	Material Selection	Choose either Steel or Aluminum		

¹. The device will allow users to set a minimum power of 0 W. However, the minimum allowable power for laser processing is 200 W.

². Pulse waveform shapes 1-10 are created by the user and 11-20 are preset by Miller.

Above parameter settings need to be configured to operate in "PULSED" mode. The min and max allowable settings are specified.

Parameter definitions are specified in the glossary of terms in section 8.4 [[▶125](#)].

8.2.4 HPP Mode Parameters - Reflective Materials

#	Parameter	Dimension	Min	Max
1	Laser Power ¹	W	0 / 300	3000
2	Wobble Frequency	Hz	0	300
3	Wobble Length	mm	0	5.0
4	Pulse Frequency	Hz	40	1500
5	Pulse Duty Cycle	%	0	20
6	Waveform Program N ²	1	0	20
7	Material Selection	Choose between Steel or Aluminum		

1. The device will allow users to set a minimum power of 0 W. However, the minimum allowable power for laser processing is 300 W.
2. Pulse waveform shapes 1-10 are created by the user and 11-20 are preset by Miller.

Above parameters settings need to be configured to operate in “HPP” mode. The min and max allowable settings are specified.

Parameter definitions are specified in the glossary of terms in section 8.4 [▶ 125](#).

8.2.5 STITCH Mode Parameters - Stitch Welding

#	Parameter	Dimension	Min	Max
1	Laser Power ¹	W	0 / 200	2000
2	Wobble Frequency	Hz	0	300
3	Wobble Length	mm	0	5.0
4	Ramp Up Time	ms	0	2000
5	Laser On Time ²	ms	0	35000
6	Ramp Down Time	ms	0	2000
7	Laser Off Time ³	ms	0	35000
8	Stitch Count	1	0	5000
9	Material Selection	Choose either Steel or Aluminum		

1. The device will allow users to set a minimum power of 0 W. However, the minimum allowable power for laser processing is 200 W.
2. When using the front panel knob, Laser On Time is controlled in units of seconds, with 0.1 s resolution. On the web page it is controlled in ms (finer resolution).
3. When using the front panel knob, Laser Off Time is controlled in units of seconds. The displayed value will be an integer value between 0 and 35 s. On the web page it is controlled in ms (finer resolution).

Above parameters settings need to be configured to operate in “STITCH” mode. The min and max allowable settings are specified.

Parameter definitions are specified in the glossary of terms in section 8.4 [▶ 125](#)].

8.2.6 CLEAN Mode Parameters

#	Parameter	Dimension	Min	Max
1	Laser Power ¹	W	0 / 200	2000
2	Wobble Frequency	Hz	0	300
3	Wobble Length	mm	0	15.0
4	Pulse Frequency	kHz	10	60
5	Pulse Duty Cycle	%	0	100

- ¹. The device will allow users to set a minimum power of 0 W. However, the minimum allowable power for laser processing is 200 W.

Above parameter settings need to be configured to operate in “CLEAN” mode. The min and max allowable settings are specified.

Parameter definitions are specified in the glossary of terms in section 8.4 [▶ 125](#)].

8.2.7 ADV STITCH Mode Parameters

#	Parameter	Dimension	Min	Max
1	Laser Power ¹	W	0 / 200	2000
2	Wobble Frequency	Hz	0	300
3	Wobble Length	mm	0	5.0
4	Laser On Time ²	ms	0	35000
5	Laser Off Time ³	ms	0	35000
6	Stitch Count	1	0	5000
7	Waveform Program N ⁴	1	0	20
8	Material Selection	Choose either Steel or Aluminum		

- ¹. The device will allow users to set a minimum power of 0 W. However, the minimum allowable power for laser processing is 200 W.
- ². When using the front panel knob, Laser On Time is controlled in units of seconds, with 0.1 s resolution. On the web page it is controlled in ms (finer resolution).
- ³. When using the front panel knob, Laser Off Time is controlled in units of seconds. The displayed value will be an integer value between 0 and 35 s. On the web page it is controlled in ms (finer resolution).
- ⁴. Pulse waveform shapes 1-10 are created by the user and 11-20 are preset by Miller.

Above parameters settings need to be configured to operate in “ADV STITCH” mode. The min and max allowable settings are specified.

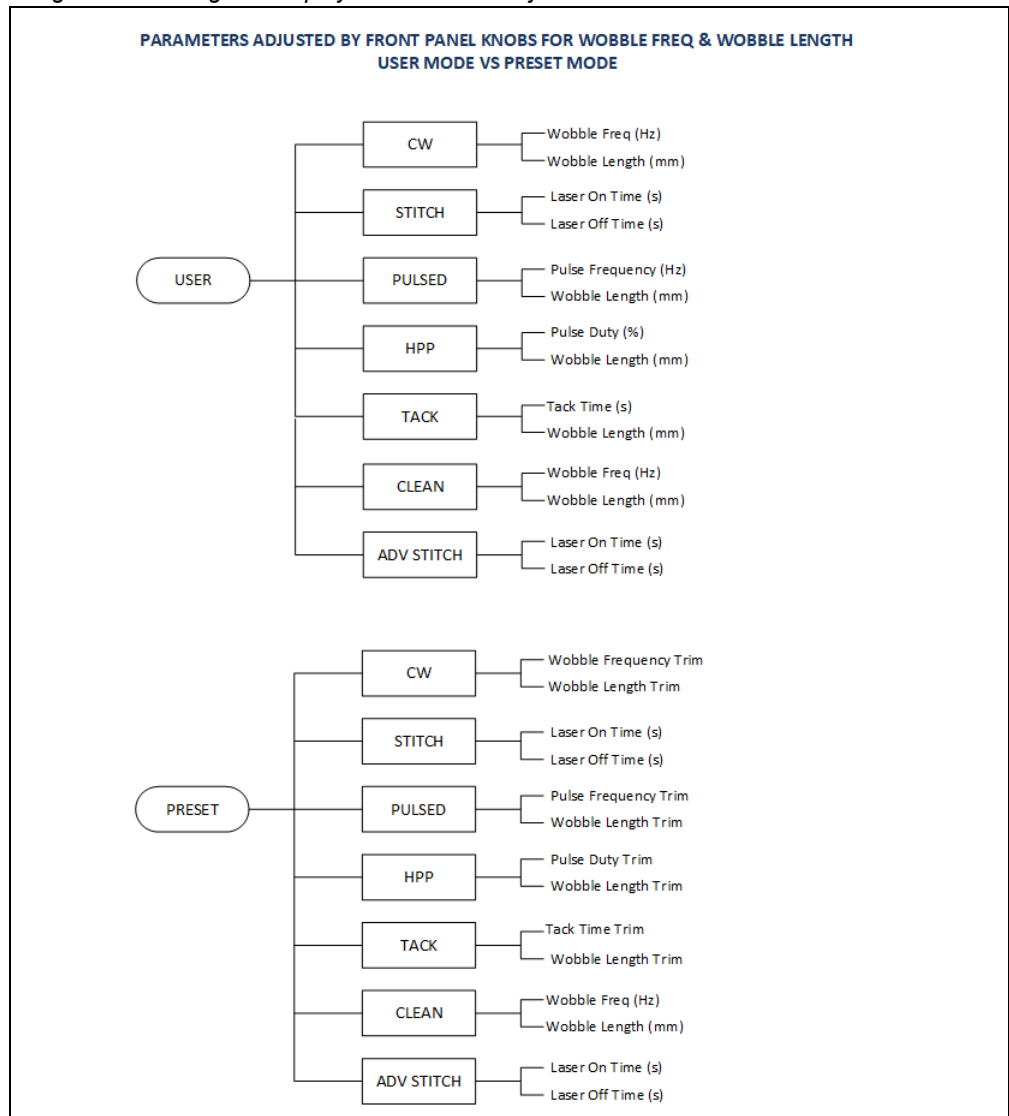
Parameter definitions are specified in the glossary of terms in section 8.4 [▶125].

8.3 Front Panel Knob Adjustments

IMPORTANT

- As different User or Preset Program Modes are selected, the front panel rotary knob adjustment parameters will change. The Laser Power control knob will remain the same for all program recipes. However, the Wobble Frequency and Wobble Length knob adjustments will have different meanings.
- For example, if a preset program is running in Stitch Mode, the two knobs will adjust Laser On Time and Laser Off Time instead. When the adjustment is no longer Hz and mm (because it is running in a different mode), the Hz and mm units of the front panel display will not light up.

▼Figure 38. Program Display Control Knob Adjustments



Front Panel allowed knob adjustment of the parameters for each laser welding mode of operation are shown in Table 29 [▶124].

▼ Table 29. Front Panel Knob Adjustment Range vs Weld Program Setting

#	Laser Mode	Parameter Adjusted by Knob Wobble Frequency 	Parameter Adjusted by Knob Wobble Length 
PRESET MODE			
0	CW	Wobble Frequency Adjustment Range: +/- 90	Wobble Length Adjustment Range: +/- 9
1	Stitch	Laser On Time Adjustment Range: 0 - 35 s	Laser Off Time Adjustment Range: 0 - 35 s
2	Pulsed	Pulse Frequency Adjustment Range: +/- 90	Wobble Length Adjustment Range: +/- 9
3	HPP	Pulse Duty Adjustment Range: +/- 90	Wobble Length Adjustment Range: +/- 9
4	Tack	Tack Time Adjustment Range: +/- 90	Wobble Length Adjustment Range: +/- 9
5	Clean	Wobble Frequency Adjustment Range: NONE Required frequency automatically calculated based on set wobble length. This knob is disabled. Display will show "0" for this control.	Wobble Length Adjustment Range: 0 - 15 mm
6	Adv Stitch	Laser On Time Adjustment Range: 0 - 35 s	Laser Off Time Adjustment Range: 0 - 35 s
USER MODE			
0	CW	Wobble Frequency Adjustment Range: 0 to 300 Hz	Wobble Length Adjustment Range: 0 to 5 mm
1	Stitch	Laser On Time Adjustment Range: 0 - 35 s	Laser Off Time Adjustment Range: 0 - 35 s
2	Pulsed	Pulse Frequency Adjustment Range: 0 to 500 Hz	Wobble Length Adjustment Range: 0 to 5 mm
3	HPP	Pulse Duty Adjustment Range: 0 to 20%	Wobble Length Adjustment Range: 0 to 5 mm
4	Tack	Tack Time Adjustment Range: 0 to 3.5 s	Wobble Length Adjustment Range: 0 to 5 mm
5	Clean	Wobble Frequency Adjustment Range: 0 - 300 Hz	Wobble Length Adjustment Range: 0 - 15 mm
6	Adv Stitch	Laser On Time Adjustment Range: 0 - 35 s	Laser Off Time Adjustment Range: 0 - 35 s

8.4 Glossary of Program Parameter Terms

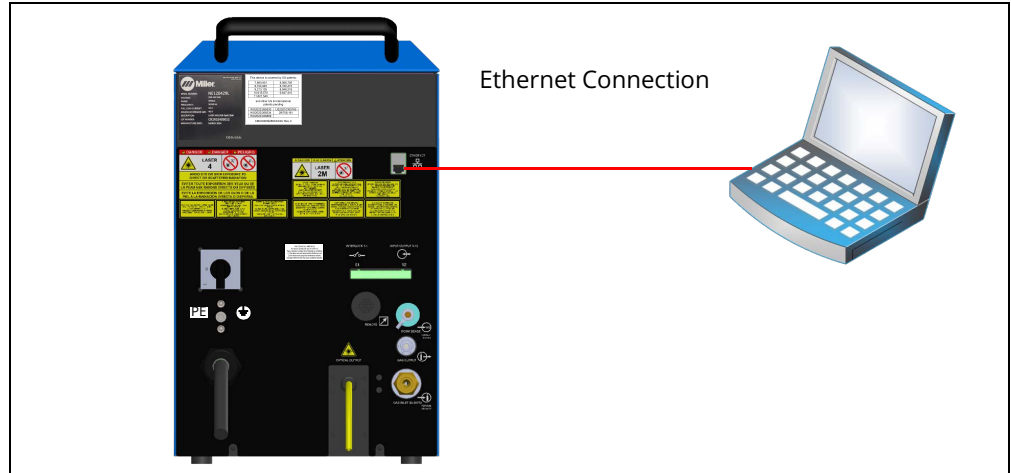
#	Name of Parameter	Unit	Definition of Term
1	Mode		The main operating configuration of the welder unit via the operator. There are 2 modes of operation: User and Preset modes.
2	Program Number		User mode: Program number consists of two numerical digits (e.g. 01). Preset mode: Program number has one letter and one numerical digit (e.g. A1).
3	Program Group		User mode: Only one program group. Preset mode: There are ten program groups (A, C, E, F, H, J, L, P, U, and Y).
4	Laser Mode		Laser mode may be set to either: (0) CW, (1) Tack, (2) Pulsed, (3) HPP, (4) Stitch, (5) Clean - XR models, or (6) Adv Stitch. Dictates which parameters the device will use for generating the laser output.
5	Laser Power	W	Sets the laser output power (or peak power in HPP mode).
6	Wobble Frequency	Hz	Sets the desired wobble device sinusoid frequency. The actual frequency is a function of the wobble length, and as such can be a smaller value if the requested frequency is outside of the range allowed by the wobble length.
7	Wobble Length	mm	Sets the desired wobble length (line length). This affects the magnitude of deflection of the laser beam via the galvanometer.
8	Ramp Up Time	ms	Rising rate of laser power.
9	Ramp Down Time	ms	Falling rate of laser power.
10	Laser ON Time	ms	For non-pulsed modes, determines time for laser to stay ON after emission trigger. Only applicable for "Stitch Mode". NOTE: Front panel knob unit is seconds. Webpage unit is ms.
11	Laser OFF Time	ms	For non-pulsed modes, determines time for laser to stay OFF after ON time. Only applicable for "Stitch Mode". NOTE: Front panel knob unit is seconds. Webpage unit is ms.
12	Pulse Frequency	Hz	For pulsed modes, determines repetition rate. NOTE: When using CLEAN laser mode the unit is kHz (not Hz).
13	Pulse Duty Cycle	%	For pulsed modes, determines ON period of laser power.
14	Wave Number		For pulsed modes, selects the pulse shape waveform to use for the pulse. Wave number 1-10 is allocated for user to create. Wave number 11-20 is Miller Preset.
15	Stitch Count		For "Stitch Mode", determines the number of pulses to generate before turning emission OFF.
16	Tack Time	ms	For "Tack Mode", determines the time to keep laser on before emission turns OFF on its own.
17	Material		Select the type of material being welded (e.g. steel, aluminum).

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9 Computer Connection to Device

To access the welder unit's webpage interface, users must first connect their PC to the welder unit's Ethernet port with the supplied Ethernet cable.

▼ Figure 39. Connect Ethernet Cable from Laser Device to Host PC



9.1 Ethernet Connection

The laser welder device uses a fixed static IP address. In order to communicate with the laser welder, the host computer should be configured to have a static address and to be on the same subnet with the laser. Refer to Table 30 [▶127], which indicates the default IP configuration for the laser welder and the IP settings to use when configuring the user's PC to communicate with the welder.

▼ Table 30. Default IP Configuration for Laser Device and Host Computer

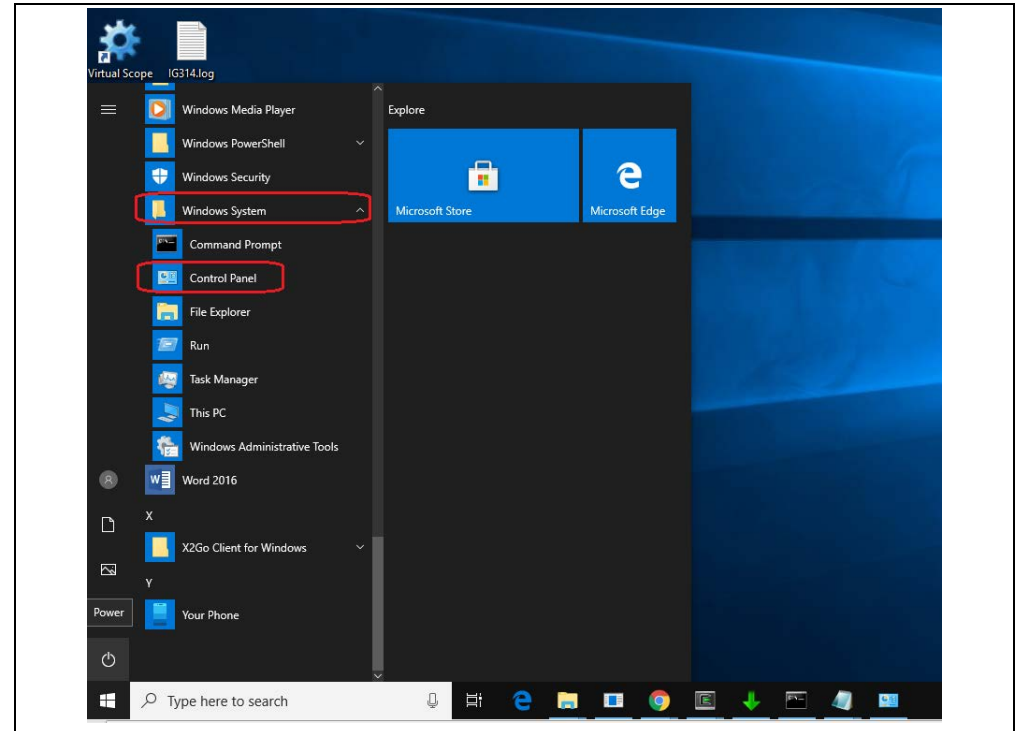
	Welder Device Factory Default Settings	Configure User's Host PC To Communicate with Welder
IP Address	10.0.0.20	10.0.0.1
Subnet Mask	255.255.255.0	255.255.255.0
Default Gateway	10.0.0.1	Leave Blank

To configure the local area connection on the host computer refer to section 9.1.1 [▶128] - Computer running WINDOWS 10 OS

9.1.1 PC Ethernet Configuration - WINDOWS 10 OS

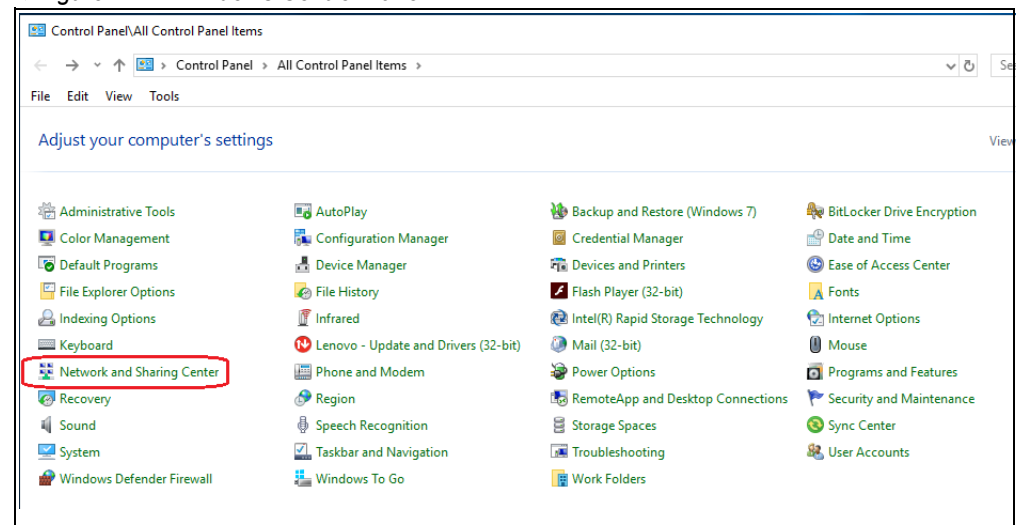
1. Open Windows **Start Menu**. Scroll down and expand the folder **Windows System**. Select **Control Panel**. See Figure 40 [▶ 128].

▼ Figure 40. Windows Start Menu



2. The Control Panel window opens. Select **Network and Sharing Center** from list See Figure 41 [▶ 128].

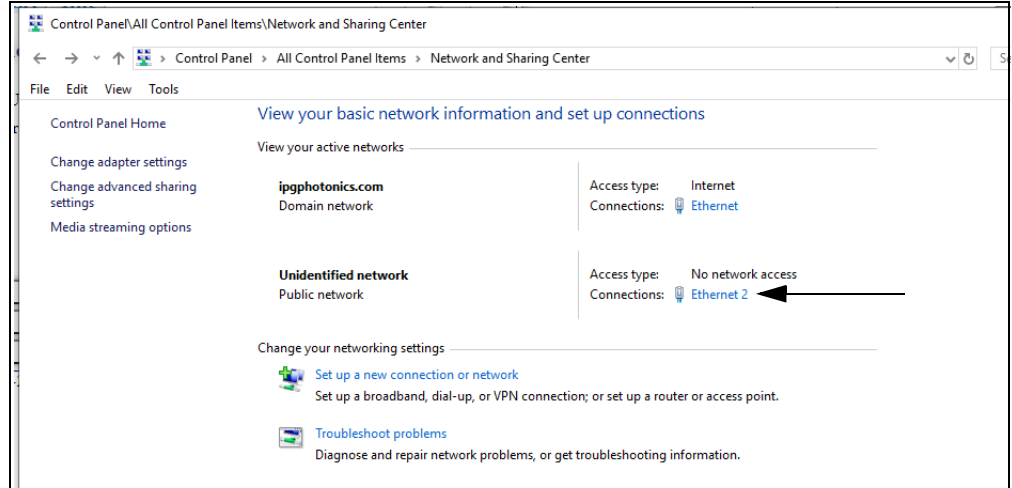
▼ Figure 41. Windows Control Panel



3. The **Network and Sharing Center** window opens:

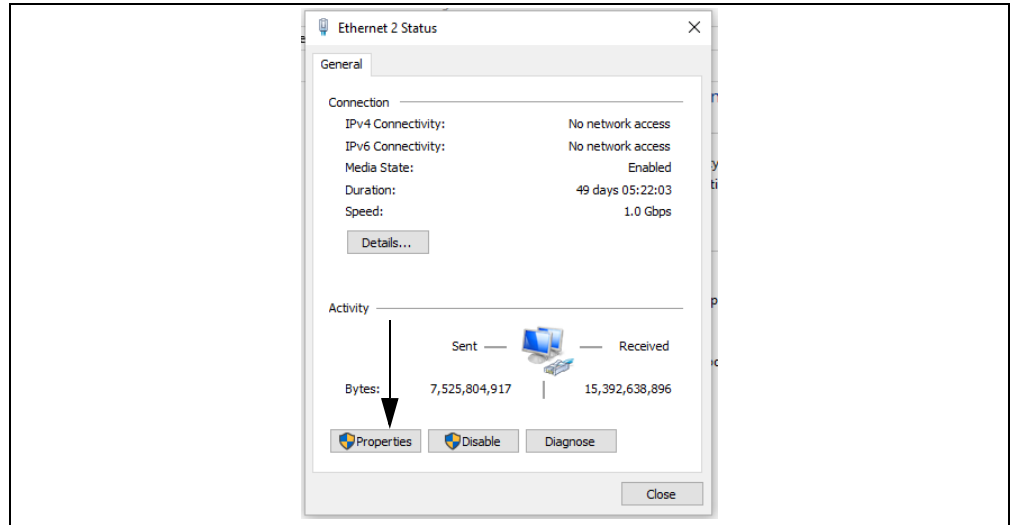
- In the active networks list, click on the Local Area Connection corresponding to your network interface or USB-Ethernet adapter (it might be labeled as “Unidentified network”). In this example it is Ethernet 2. See Figure 42 [▶ 129].

▼ Figure 42. Network & Sharing Center Window



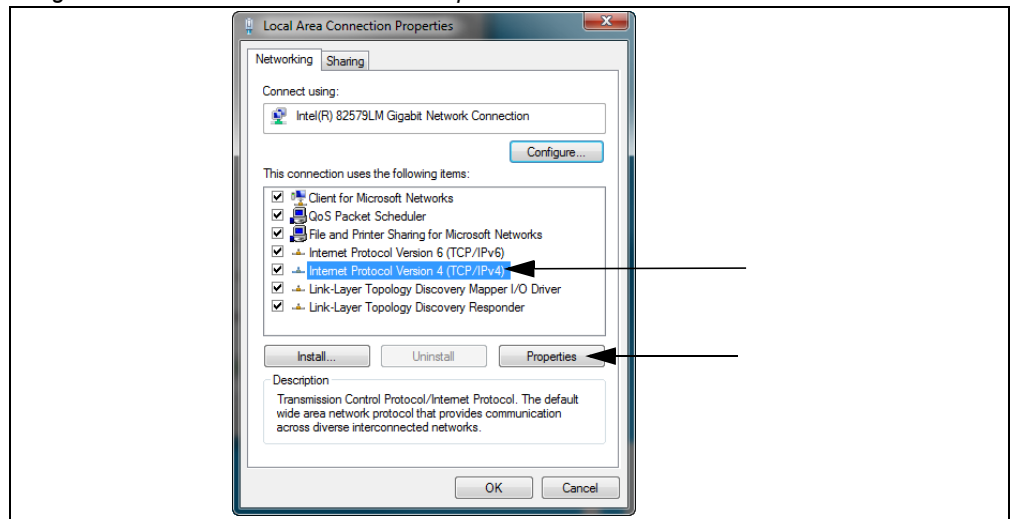
4. On the Local Area Connection's **Status** window click on **Properties** button—see Figure 43 [▶ 129].

▼ Figure 43. Local Area Connection Status Window



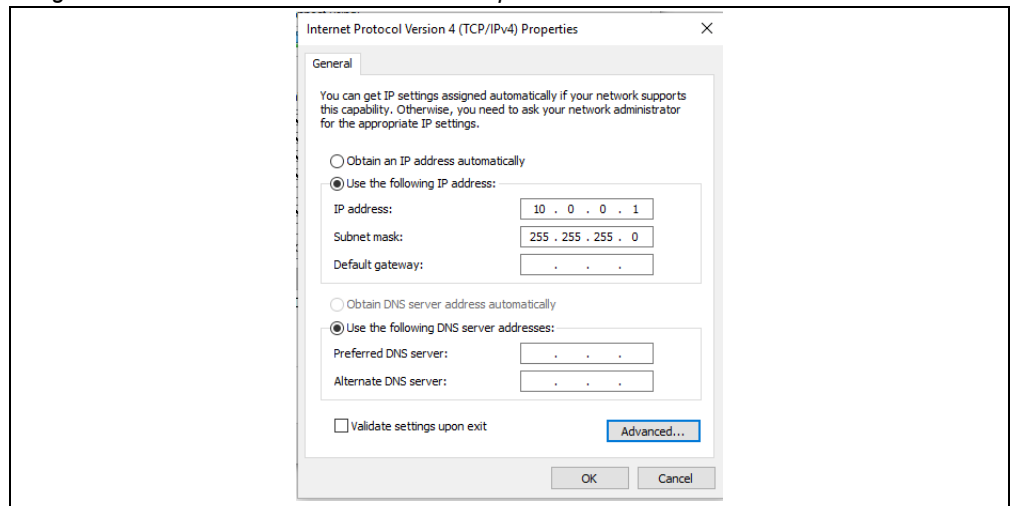
5. On the **Local Area Connection Properties** window:
 - Select **Internet Protocol Version 4 (TCP/IPv4)**.
 - Click the **Properties** button - see Figure 44 [▶ 130].

▼ Figure 44. Local Area Connection Properties Window



6. Select **Use the following IP address**. Fill out entries and click **OK** - see Figure 45 [▶ 130].
- IP address - 10.0.0.1 (for example)***
 - Subnet Mask - 255.255.255.0
 - Default Gateway - Leave it blank

▼ Figure 45. Internet Protocol Version 4 Properties Window



9.2 Webpage Interface

The webpage interface can be used to view, create or modify program recipes. It can also be used to monitor the device status, view warning and alarm bits, as well view firmware revision information.

If you are experiencing technical support issues, use the diagnostic information available through the webpage interface and provide it to an Miller technical support representative (refer to section B.1 [▶169]).

IMPORTANT

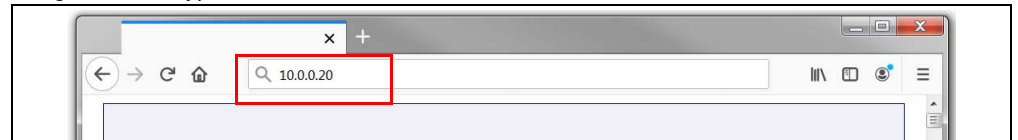
Depending on the firmware revision installed, some of the screens and features may not look exactly the same as what is shown here.

9.3 Accessing Device Webpages

To access the device webpage interface, it is recommended to use an updated version of Google Chrome or Firefox web browser. If you haven't already done so, setup your computer connection as instructed in section 9.1 [▶127].

1. Open web browser.
2. In the address search bar, type the IP address for the device (default is **10.0.0.20**) then press the **Enter** key (see Figure 46 [▶131]).

▼ Figure 46. Type Device Default IP Address Here



3. If successful, you will be directed to the Welder Page (see Figure 47 [▶131]). The webpage will display the model name at the top.

▼ Figure 47. Tabs to switch between device webpages



Select from three available tabs to navigate between device webpages:

- **Welder** - Opens the main Welder page (see section 9.4 [▶132]). Weld program creation is performed here. Welder status and error information is found here.
- **Settings** - Opens the Network Settings page (see section 9.5 [▶138]). The network IP address configuration for the device is performed here.
- **Support** - Opens the Product Support page. Software and firmware revision information is located here (see section 9.6 [▶139]).
- **Login/Logout** - This login is intended to be used by Miller personnel to access factory device settings.

9.4 Laser Welder Page

To access the Laser **Welder** page, click on the **Welder** tab.

The **Welder** page enables the user to perform similar and/or equivalent functions as what is done via the device front panel controls. Refer to Figure 48 [▶ 132] and Figure 49 [▶ 133].

The **Welder** page is broken down into two sections. On the left-hand side of the page will be the Weld Program Setup. On the right-hand side of the page is the Welder Device Status Indicators.

When the **Welder** Page first opens it will automatically show the weld program currently set on the welder unit. In the section called **Controls** it will specify the type of program, either USER or Preset Program Letter (e.g. A).

The index will specify the number of the program. For example, user program number 1 or Preset group A index number 1 for program A1. To change between User and Preset, in the **Controls** section, click to display the "Program:" drop down menu and make selection. Then type the Index number and press the enter key. The weld program parameters and settings will change accordingly.

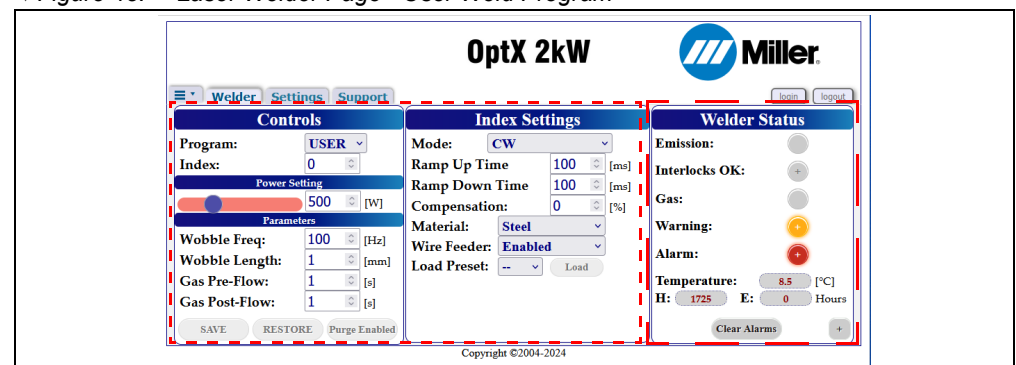
If changes are made to a program via the unit's front panel control knobs and buttons, those changes will automatically be updated and shown on the **Welder** Page. Alternatively, any changes made on the **Welder** Page will automatically be updated to the unit.

Clicking on the **Save** button to save changes made to the current weld program. Clicking on the **Restore** button will revert the currently displayed weld program to the factory default settings.

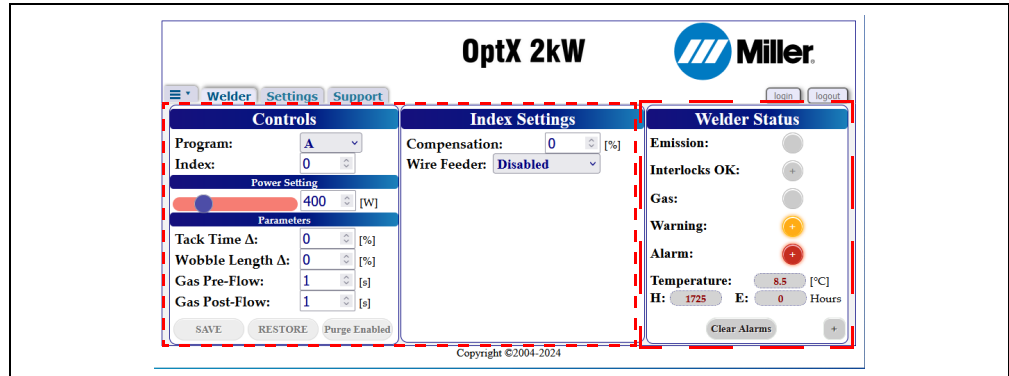
The **Gas Pre-Flow** and **Gas Post-Flow** times are global settings that apply to all program modes. Users can set a time between 0.1 to 10 seconds. These values can also be set using the Front Panel Setup mode (refer to Table 25 [▶ 97]).

Click on **Purge Enabled / Purge Disabled** button to turn on/off the purge gas function. This is a global setting. The wording on this button will toggle between Enabled or Disabled depending on the what the current setting is set to. This feature can also be enabled/disabled using the Front Panel Setup mode (refer to Table 25 [▶ 97]).

▼ Figure 48. Laser Welder Page - User Weld Program



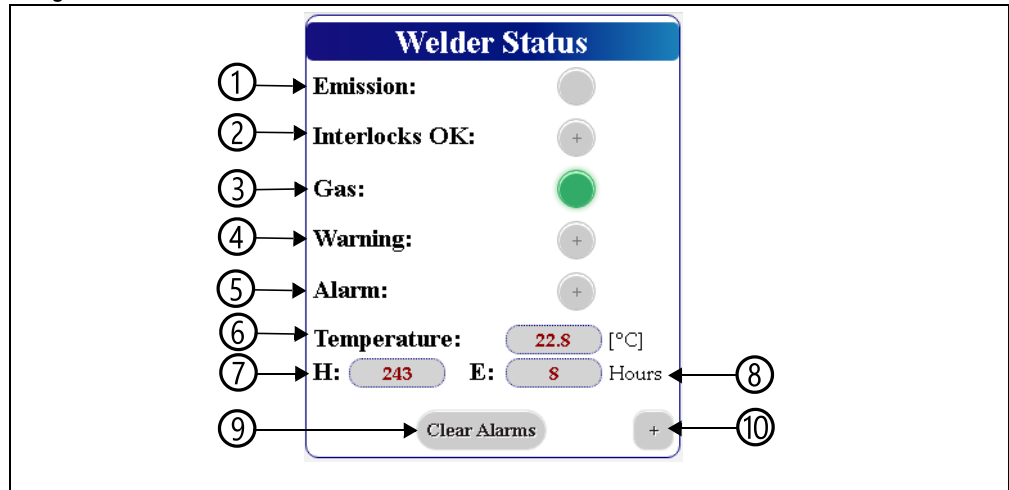
▼ Figure 49. Laser Welder Page - Preset Weld Program



9.4.1 Welder Status Indicator Pane

The **Welder Status** panel is a graphical representation of the unit's front panel indicators and will enable users to troubleshoot which particular status or alarm bits are causing the error or warning. For description of features, refer to Table 31 [▶ 133].

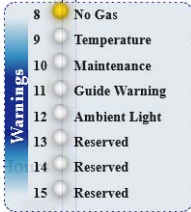
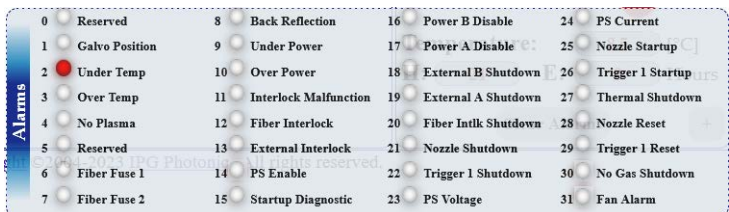
▼ Figure 50. Welder Status Indicator Panel



▼ Table 31. Welder Status Indicator Pane Features

ITEM	Feature	Description
1	Emission	Indicator is lit yellow when emission is enabled
2	Interlocks OK ¹ Interlocks 0 Nozzle OK 1 Software Enable 2 FPGA Enable 3 Trigger 1 OK 4 External B OK 5 External A OK 6 Fiber Interlocks OK 7 Key Interlocks OK 8 Trigger 2 OK	- When all interlocks are satisfied, the main indicator in the Welder Status pane is lit green. - Click on the round plus button ("+") to pop open the Interlocks pane. This pane lists all of the system interlocks that need to be satisfied before laser welding can begin. - If the indicators are lit green it means interlock status is OK. - To close (collapse) the Interlocks pane, click on the round minus button (i.e. "-").
3	Gas	The main indicator on the Welder Status pane is lit green if there is sufficient gas pressure coming into the device from gas supply.

▼ Table 31. Welder Status Indicator Pane Features (Continued)

ITEM	Feature	Description
4	Warning ¹ 	- The main Warning indicator will be lit yellow when there is a warning. If there are no warnings, it will not be lit (gray). - Click on the round plus button (“+”) to pop open the Warnings pane. This pane lists the warnings. - Currently there are warnings for: No Gas, Temperature, the Guide Laser not working, Maintenance and Ambient Light. - Temperature and Guide Laser Warnings do not prevent emission from being turned on and will not turn off emission. Ambient Light Warning - Indicates that the lighting in the work environment can cause the plasma alarm to not operate effectively. This is typically caused when the surrounding light is periodically pulsing/modulating at a high enough lux level that it can be confused for plasma by the detector. Conditions for generating this warning is observed right after all interlocks are satisfied (Trigger 1 pressed, nozzle touching part, ready to weld). The ambient light warning can be cleared by releasing and pressing again Trigger 1 switch on the torch. If the ambient light warning is present when the user enables emission, a plasma alarm will instantly be generated. If the user sees Er04 on the front panel, and the ambient light warning is also activated, then the plasma alarm was caused by the ambient light. If the ambient light warning is not lit, then the plasma alarm is due to a lack of plasma signal. - To close (collapse) the Warnings pane, click on the round minus button (“-”).
5	Alarm	- Main Alarm indicator will be lit red when the unit is in an error state. - Click on the round plus button (“+”) to pop open the Alarms pane. This pane lists all of the error bits. During normal operation, these Indicators are not lit. When an error occurs one or more indicators might be lit red. - For more information about these error bits refer to section 10 [▶ 151]. - When there is an error, the front panel power display will specify the error code. That error code will correspond to the alarm bit number shown here (e.g. Er02 for Under Temp). - Unlike warnings, if an error occurs during welding it will turn off laser emission. - To close (collapse) the Alarms pane, click on the round minus button (“-”). 
6	Temperature (in °C) ¹	Displays the laser’s temperature reading.
7	H (in hours) ¹	Total ON hours is a cumulative timer over the lifespan of the unit.
8	E (in hours) ¹	Emission ON hours is a cumulative timer over the lifespan of the unit but only while emission was on.

▼ Table 31. Welder Status Indicator Pane Features (Continued)

ITEM	Feature	Description
9	Clear Alarms Button 	Click button to clear alarms. This will perform a similar function as clearing the alarm using the Trigger 1 control on the torch as long as the condition that caused the error in the first place was resolved.
10	Expand Advanced Settings 	- On the lower right corner of the Welder Status Pane is a button with the plus sign (+). Selecting this button expands the window and will display the Advanced Settings Options. - To close (collapse) the Advanced Settings, click on the button with the minus sign (-) again.

¹. Also viewable using Front Panel Setup Mode. Refer to Table 25 [▶97].

9.4.2 User Mode Weld Program Setup

Depending on which laser mode is selected, the weld program settings that need to be configured will change as shown in Table 33 [▶136]. For more information on a particular parameter refer to section 8 [▶119]. Some additional options are listed below.

- **Material:** There is a “Material” selection option (e.g. Steel, Aluminum, etc.) shown in the “Index Settings” pane. This will automatically set appropriate thresholds for the plasma detection feature that depend on the material type selected.
- **Wire Feeder:** The user has the ability to enable/disable usage of the wire feeder on a per weld program basis. This setting is set in the “Index Settings” pane and is available for both User programs and Presets.
- **Load Preset:** Option to “Load Preset” settings to a custom user program index. This option is found in the “Index Settings” pane.
 - First select a user program index number.
 - Then from the “Load Preset” drop down list the user selects a preset program to copy (e.g. A2).
 - Click the **Load** button to copy the preset settings (e.g. from A2) to the user index selected (e.g. user index 0).
 - Once the settings are copied, the user can then customize the settings and save as one of their own recipes.
- **Compensation:** Set power compensation between 0% (Default) and 100% for each user program and preset. This setting is applicable for welding operations. Power compensation will be handled automatically when using Clean laser mode. Refer to Table 32 [▶136].
 - When the beam wobble device (inside the torch) is sweeping the beam back and forth in the cross-axis, it needs to slow down at the edges so that it can turn around and sweep the beam in the opposite direction. This compensation percentage is used to improve the “tooth” in the weld process (where at the edges, the weld would penetrate more deeply than at the center.) As a result, users may want to compensate for the edge dwell time by decreasing the laser power at the edges compared to the center of the weld. The amount of compensation needed is inversely proportional to the edge depth and can change based on the material and thickness of the parts being welded.

▼ Table 32. Effects of Power Compensation Setting

Example Power Setpoint in Weld Program	Power Compensation Setting	Power used at the center of the weld	Power used at the edges of the weld
1000 W	0% (Default)	1000 W	1000 W
1000 W	40%	1000 W	600 W
1000 W	100%	1000 W	0 W

The table below shows the webpage weld program configuration panels for each laser mode of operation.

▼ Table 33. User Mode Weld Program Configuration for Each Laser Mode

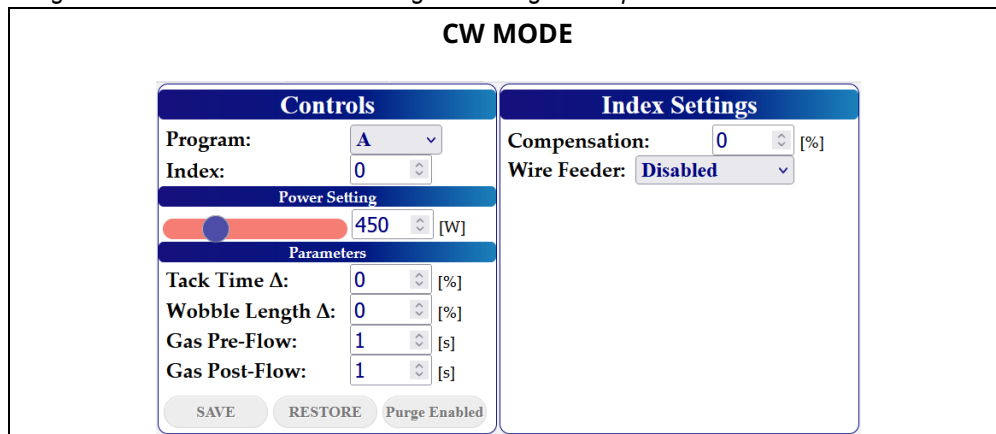
Laser Mode	User Mode Weld Program Configuration
CW	Controls Program: USER Index: 0 Power Setting: 500 [W] Parameters: Wobble Freq: 100 [Hz] Wobble Length: 1 [mm] Gas Pre-Flow: 1 [s] Gas Post-Flow: 1 [s] SAVE RESTORE Purge Enabled Index Settings Mode: CW Ramp Up Time: 100 [ms] Ramp Down Time: 100 [ms] Compensation: 0 [%] Material: Steel Wire Feeder: Enabled Load Preset: -- Load
TACK	Controls Program: USER Index: 0 Power Setting: 500 [W] Parameters: Wobble Freq: 100 [Hz] Wobble Length: 1 [mm] Gas Pre-Flow: 1 [s] Gas Post-Flow: 1 [s] SAVE RESTORE Purge Enabled Index Settings Mode: TACK Ramp Up Time: 100 [ms] Ramp Down Time: 100 [ms] Tack Time: 0 [ms] Compensation: 0 [%] Material: Steel Wire Feeder: Enabled Load Preset: -- Load
PULSED	Controls Program: USER Index: 0 Power Setting: 500 [W] Parameters: Wobble Freq: 100 [Hz] Wobble Length: 1 [mm] Gas Pre-Flow: 1 [s] Gas Post-Flow: 1 [s] SAVE RESTORE Purge Enabled Index Settings Mode: PULSED Pulse Frequency: 0 [Hz] Pulse Duty: 0 [%] Pulse Wave #: 1 Compensation: 0 [%] Material: Steel Wire Feeder: Enabled Load Preset: -- Load

▼ Table 33. User Mode Weld Program Configuration for Each Laser Mode (Continued)

Laser Mode	User Mode Weld Program Configuration
HPP	Controls Program: USER Index: 0 Power Setting: 500 [W] Parameters: Wobble Freq: 100 [Hz] Wobble Length: 1 [mm] Gas Pre-Flow: 1 [s] Gas Post-Flow: 1 [s] SAVE RESTORE Purge Enabled Index Settings Mode: HPP Pulse Frequency: 100 [Hz] Pulse Duty: 0 [%] Pulse Wave #: 1 Compensation: 0 [%] Material: Steel Wire Feeder: Enabled Load Preset: -- Load
STITCH	Controls Program: USER Index: 0 Power Setting: 500 [W] Parameters: Wobble Freq: 100 [Hz] Wobble Length: 1 [mm] Gas Pre-Flow: 1 [s] Gas Post-Flow: 1 [s] SAVE RESTORE Purge Enabled Index Settings Mode: STITCH Ramp Up Time: 100 [ms] Ramp Down Time: 100 [ms] Laser On Time: 0 [ms] Laser Off Time: 0 [ms] Stitch Count: 0 Compensation: 0 [%] Material: Steel Wire Feeder: Enabled Load Preset: -- Load
CLEAN	Controls Program: USER Index: 0 Power Setting: 500 [W] Parameters: Wobble Freq: 100 [Hz] Wobble Length: 1 [mm] Gas Pre-Flow: 1 [s] Gas Post-Flow: 1 [s] SAVE RESTORE Purge Enabled Index Settings Mode: CLEAN Pulse Frequency: 10 [KHz] Pulse Duty: 0 [%] Compensation: 0 [%] Wire Feeder: Enabled Load Preset: -- Load
ADV STITCH	Controls Program: USER Index: 0 Power Setting: 500 [W] Parameters: Wobble Freq: 100 [Hz] Wobble Length: 1 [mm] Gas Pre-Flow: 1 [s] Gas Post-Flow: 1 [s] SAVE RESTORE Purge Enabled Index Settings Mode: ADV. STITCH Pulse Wave #: 1 Laser On Time: 0 [ms] Laser Off Time: 0 [ms] Stitch Count: 0 Compensation: 0 [%] Material: Steel Wire Feeder: Enabled Load Preset: -- Load

9.4.3 Preset Mode Weld Program Setup

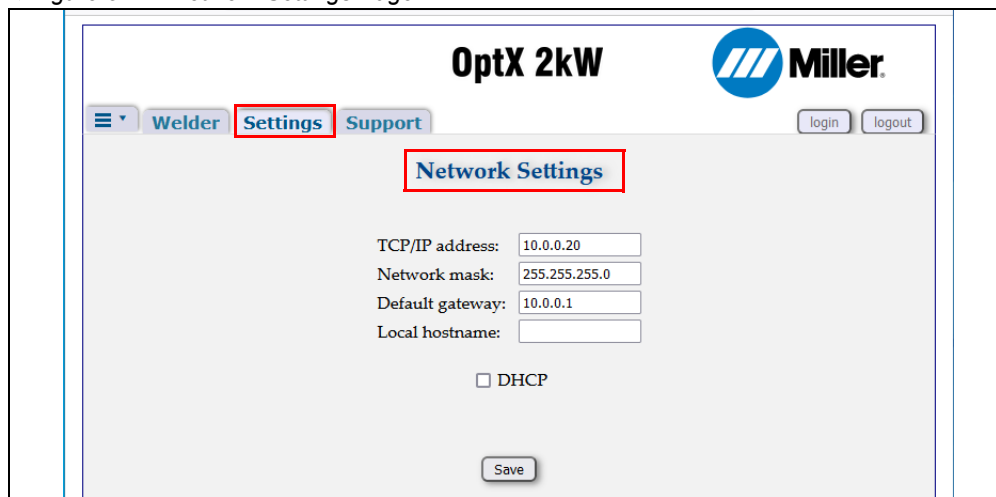
▼ Figure 51. Preset Mode Weld Program Configuration per Laser Mode



9.5 Network Settings Page

To access the Network Settings webpage, click on the **Settings** tab. The Network Settings page enables the user to view or change the TCP/IP settings for the device. See Figure 52 [▶ 138].

▼ Figure 52. Network Settings Page



- Displays current Network Settings, except if DHCP is enabled.
For DHCP Enabled, these fields will display default network settings that will be used only in the case where the device was unable to connect to the DHCP assigned IP Address at startup.
- User may change these settings by inputting the new network setting in the field (press **Enter** key).
- Click **Save** button to confirm changes.
- Must reboot device for changes to take effect.

IMPORTANT

Do not change the "Local hostname".

9.6 Product Support Page

To access the Product Support webpage, click on the **Support** tab.

The Product Support page displays:

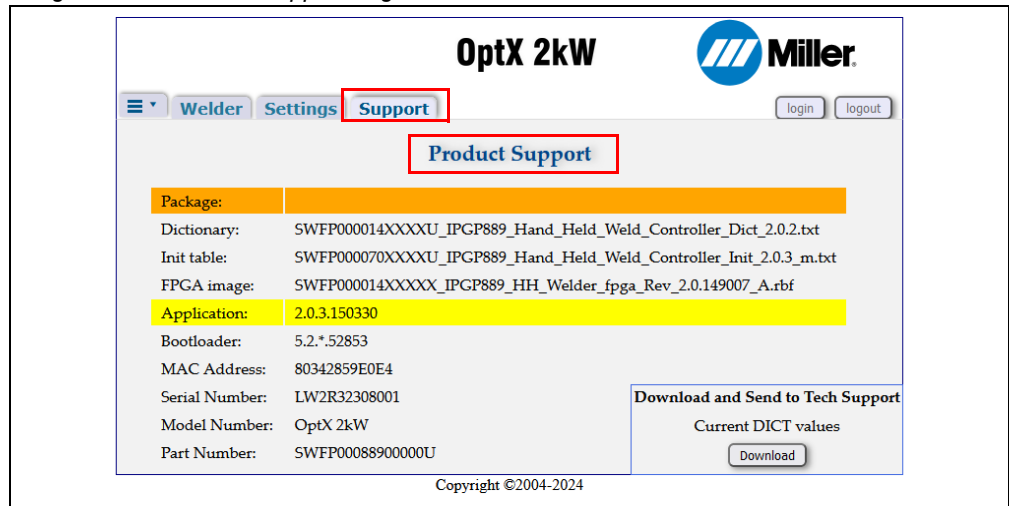
- Software and Firmware revision information.
- Device serial number, model name and part number.
- Device MAC Address

Click on the **Download** button to download the unit configuration settings. A binary file will be saved into the **Downloads** folder. The name of the downloaded file will be: **dict_values_download_serialnumber.bin**.

Should you experience technical issues with your device, provide your Miller support representative: (1) a screen shot of this page, (2) the downloaded binary file.

This information will assist in troubleshooting the issue (see Figure 53 [▶ 139]).

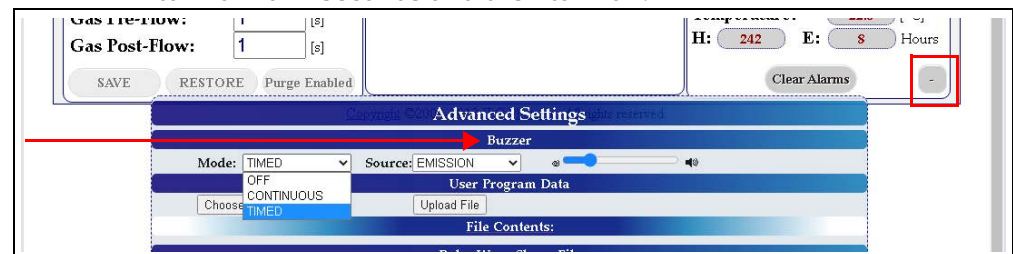
▼ Figure 53. Product Support Page



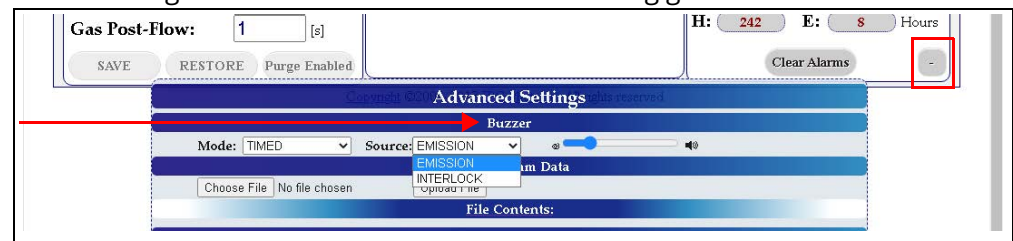
9.7 Buzzer Setup - Advanced Settings

For instructions on accessing the device webpage refer to section 9.3 [▶131].

1. Click the + button on the bottom right of the main user webpage to expand the Advanced Settings section of the webpage.
2. Go to the **Buzzer** section under Advanced Settings and select the **Mode**.
 - **OFF** - Buzzer is not configured and will not activate.
 - **CONTINUOUS** - This turns the buzzer on continuously for as long as the condition specified in **Source** remains satisfied.
 - **TIMED** - As soon as the condition specified in **Source** is satisfied the buzzer will turn on for 2 seconds and then turn off.



3. Next select the **Source**.
 - **EMISSION** - Buzzer will activate when laser emission turns on. All the interlocks are satisfied, the nozzle tip is touching the part and the torch Trigger 2 switch was pressed. The Emission ON indicator on the front panel of the device is lit and the torch indicator is lit red.
 - **INTERLOCK** - Buzzer will activate once all the interlocks are satisfied and the nozzle tip is touching the part. Emission is not activated yet (Trigger 2 was not pressed). The interlock indicator on the front panel of the device is lit green and the torch indicator is blinking green.



4. Set the buzzer volume using the slider on the right.
Procedure is complete.

9.8 User Program Data - Advanced Settings

9.8.1 Creating User Program Data File

The user is allowed to upload their own program data to the device. User must first create their program table using a standard CSV (comma separated values) file. The file must have the following format:

PROGRAM,	INDEX,	LASER MODE,	WAVE #,	POWER,	W FREQ,	W LENGTH,	RAMP UP,	RAMP DN,	LASER ON,	LASER OFF,	STITCH #,	TACK,	FREQ,	DUTY,	COMP,	CTRL,
x,	0,	0,	1,	500,	100,	1,	100,	100,	0,	0,	0,	0,	0,	0,	0,	0,
x,	1,	0,	1,	1000,	100,	1,	100,	100,	0,	0,	0,	0,	0,	0,	0,	1,
x,	2,	0,	1,	2000,	100,	1,	100,	100,	0,	0,	0,	0,	0,	0,	0,	0,

The CSV file should contain the first row shown above, as a heading, so that the CPU is aware that the following data is a program data file. The units for each parameter is the same as what is shown in the webpage interface. Refer to section 8.4 [▶ 125](#) for listing of parameters and their description.

The CSV file does not have to define every program index number. It can contain just one, or multiple programs, up to 20, with a program index from 0 to 19.

9.8.2 Upload User Program Data File

Refer to Figure 54 [▶ 142](#) which illustrates the steps required to upload user program file.

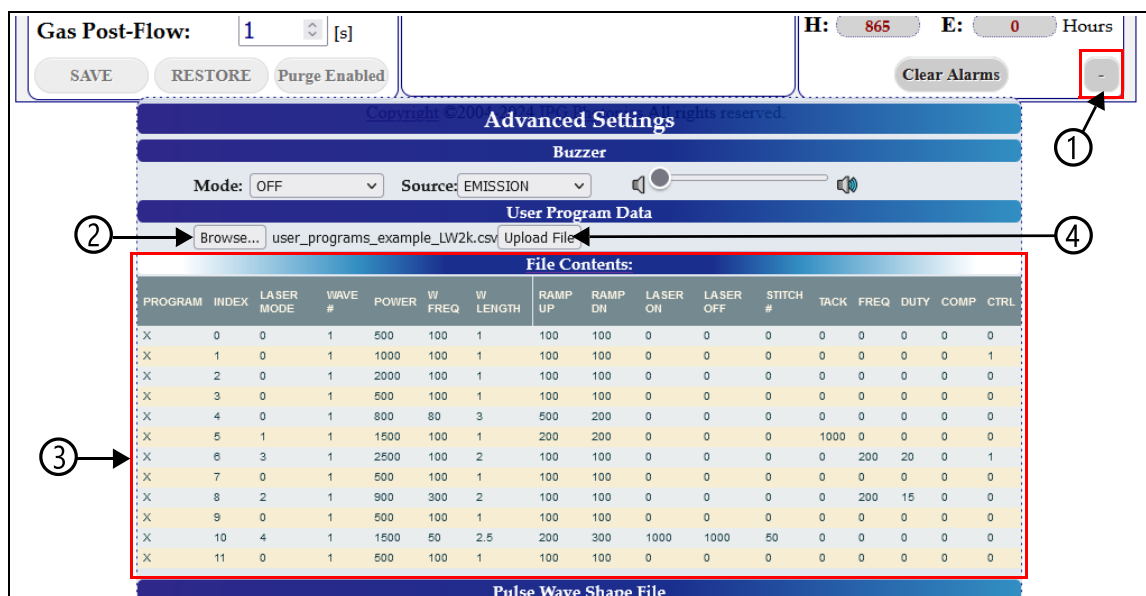
User program files can be uploaded to the welder unit via the user webpage. For instructions on accessing the device webpage refer to section 9.3 [▶ 131](#).

1. Click the **+** button on the bottom right of the page to expand the Advanced Settings section of the webpage.
2. Go to **User Program Data** section under Advanced Settings, press the **Choose file** button to upload your created CSV file. Follow the on screen prompts and dialogs to select your file.
3. Once the file is selected, a preview visualization will be presented on the screen. You can use this preview to determine if your program settings look as intended. If the program settings do not look as intended, the user must modify the CSV file then follow step 2 again to see another preview.
4. If satisfied with the program data preview, press the **Upload File** button to upload the new user programs to the CPU. Wait for the on-screen prompt which indicates that the file was successfully uploaded, before exiting from the browser.

IMPORTANT

- The figure below is just an example file. The example for user index 0 is the default settings for user index 0 to 15 (the default user index 0 to 15 programs are identical and are set for the material steel).
- The example for user index 1 is the default settings for user index 16 to 25 (the default user index 16 to 25 programs are identical and are set for the material aluminum).
- The rest of the user index programs (2 to 11) shown in the figure are just examples that were created to illustrate how to upload user programs. Users may create and upload up to 26 programs (index 0 to 25).

▼ Figure 54. Advanced Feature - Uploading User Program Data



Gas Post-Flow: 1 [s] H: 865 E: 0 Hours

SAVE RESTORE Purge Enabled Clear Alarms

Advanced Settings

Buzzer

Mode: OFF Source: EMISSION

② Browse... user_programs_example_LW2k.csv Upload File ④

File Contents:

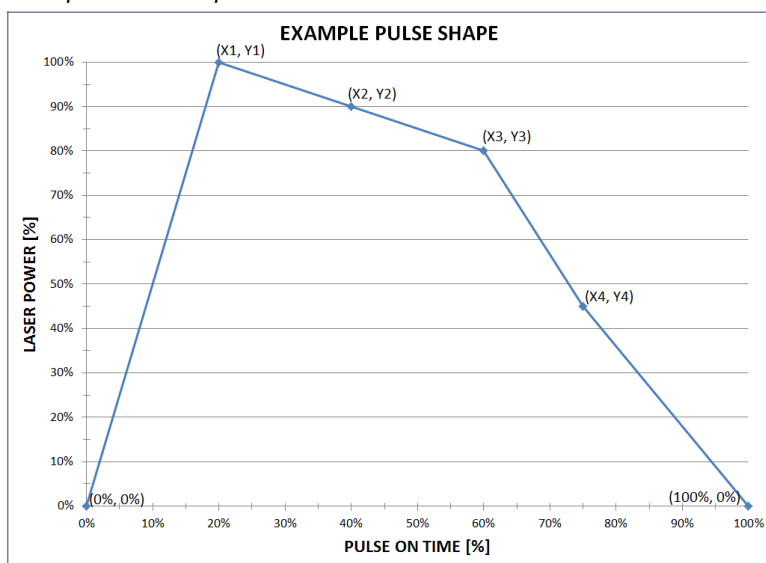
PROGRAM	INDEX	LASER MODE	WAVE #	POWER	W FREQ	W LENGTH	RAMP UP	RAMP DN	LASER ON	LASER OFF	STITCH #	TACK	FREQ	DUTY	COMP	CTRL
X	0	0	1	500	100	1	100	100	0	0	0	0	0	0	0	0
X	1	0	1	1000	100	1	100	100	0	0	0	0	0	0	0	1
X	2	0	1	2000	100	1	100	100	0	0	0	0	0	0	0	0
X	3	0	1	500	100	1	100	100	0	0	0	0	0	0	0	0
X	4	0	1	800	80	3	500	200	0	0	0	0	0	0	0	0
X	5	1	1	1500	100	1	200	200	0	0	0	1000	0	0	0	0
X	6	3	1	2500	100	2	100	100	0	0	0	0	200	20	0	1
X	7	0	1	500	100	1	100	100	0	0	0	0	0	0	0	0
X	8	2	1	900	300	2	100	100	0	0	0	0	200	15	0	0
X	9	0	1	500	100	1	100	100	0	0	0	0	0	0	0	0
X	10	4	1	1500	50	2.5	200	300	1000	1000	50	0	0	0	0	0
X	11	0	1	500	100	1	100	100	0	0	0	0	0	0	0	0

Pulse Wave Shape File

9.9 Pulse Shape Generation - Advanced Settings

Users can generate up to ten unique pulse shapes that can be selected by the pulse wave number (programs using PULSED, HPP or ADV STITCH laser mode). Each pulse shape consists of six points - four unique points, plus the starting point, and the ending point. These points are defined in percentage units, with the x-axis being percentage of pulse on time (calculated from the set frequency and duty cycle for HPP and PULSED mode), and the y-axis being percentage of set laser power. The figure below provides an example pulse shape generated from six points.

▼ Figure 55. Example Pulse Shape



When a different pulse shape is requested the CPU reads the points of the selected shape. It then converts the point units from percentages to proportional values of time period (x-axis) and laser power (y-axis). Once the points are converted the rest of the pulse shape can be derived by interpolating between each point. The interpolation is provided by the equation below where:

T = Current Time

P_{pt} = Power (y) of a given point

T_{pt} = Time (x) of a given point

$$P_{shape} = P_{pt-1} + (T - T_{pt-1}) \left[\frac{P_{pt} - P_{pt-1}}{T_{pt} - T_{pt-1}} \right]$$

9.9.1 Creating Pulse Shape Files

The pulse shapes can be created with standard CSV (comma separated values) files. The file must have the following format:

Wave #, x1, y1, x2, y2, x3, y3, x4, y4,

The CSV file should contain the above row as a heading so that the CPU is aware that the following data is a pulse shape file. Wave # is an integer value from 1 to 10. It determines what pulse wave number the subsequent data in that row is for. The rest of the values in the row are numbers from 0-100% that determine the (x,y) point pairs. Note that the first and last points are omitted since they are always fixed at (0,0) and (0,100) respectively.

The wave CSV file does not have to define every wave number. It can contain just one, or multiple pulse shapes. Below is an example of a CSV formatted data that would correspond to a wave file.

▼ Figure 56. CSV Formatted Pulse Shape Wave File

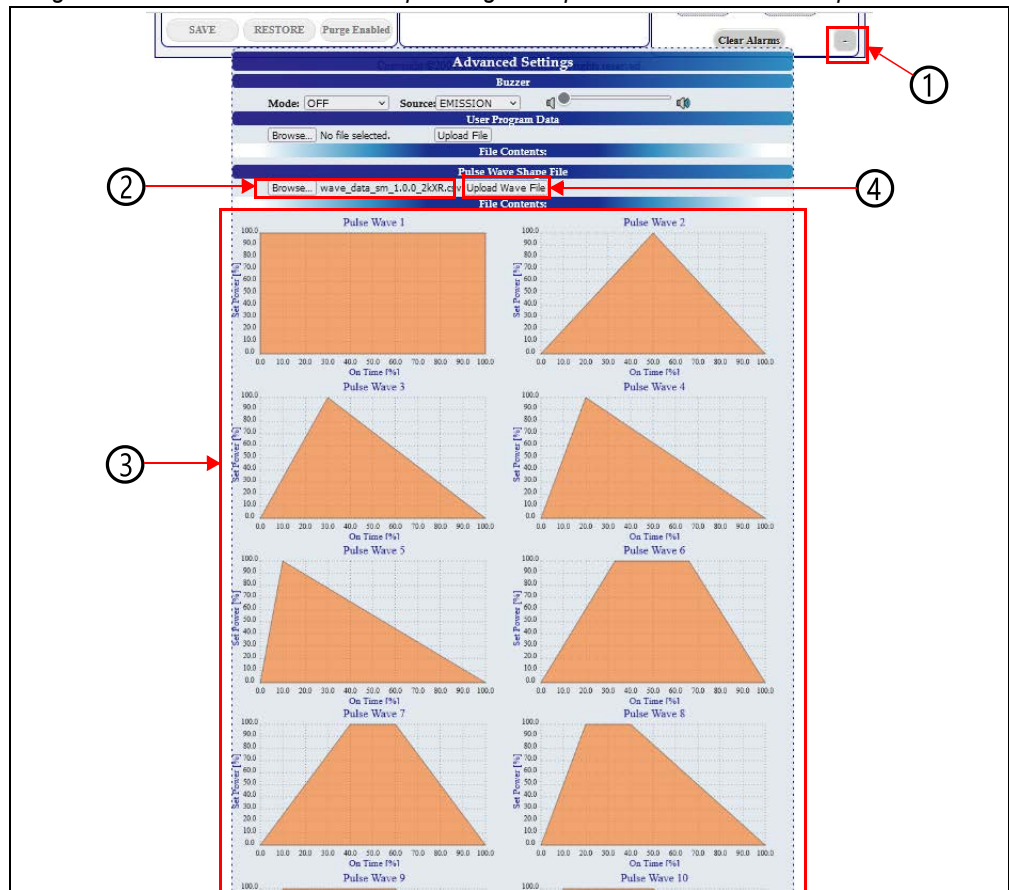
Wave #,	x1,	y1,	x2,	y2,	x3,	y3,	x4,	y4,
1,	0,	100,	100,	100,	100,	0,	100,	0,
2,	50,	100,	100,	0,	100,	0,	100,	0,
3,	30,	100,	100,	0,	100,	0,	100,	0,
4,	20,	100,	100,	0,	100,	0,	100,	0,
5,	10,	100,	100,	0,	100,	0,	100,	0,
6,	33,	100,	66,	100,	66,	100,	66,	100,
7,	40,	100,	60,	100,	60,	100,	60,	100,
8,	20,	100,	40,	100,	40,	100,	40,	100,
9,	10,	100,	60,	100,	60,	100,	60,	100,
10,	10,	100,	50,	100,	50,	100,	50,	100,

9.9.2 Uploading Pulse Shapes

Pulse shape files can be uploaded to the welder unit via the user webpage. Refer to Figure 57 [▶ 144] which illustrates these steps. For instructions on accessing the device webpage refer to section 9.3 [▶ 131].

1. Click the **+** button on the bottom right of the page to expand the Advanced Settings section of the webpage.
2. Go to **Pulse Shape File** section under Advanced Settings, press the **Choose file** button to upload your created shape file. Follow the on screen prompts and dialogs to select your pulse shape file.
3. Once the file is selected, a preview visualization will be presented on the screen of your created pulse shapes. You can use this preview to determine if your shapes look as intended. If a pulse shape is missing in the preview, it indicates that the particular shape row was malformed, and should be corrected (otherwise the CPU will ignore it). If shapes are missing, or do not look as intended, the user must modify the CSV file then follow step 2 again to see another preview.
4. If satisfied with the pulse shapes preview, press the **Upload Wave File** button to upload the new shapes to the CPU. Wait for the on-screen prompt which indicates that the pulse shapes were uploaded, before exiting from the browser.
5. To use one of these new uploaded pulse shapes, set the laser mode for your program to either **PULSED**, **HPP** or **ADV STITCH** and then set the **Pulse Wave #** for your shape (valid numbers are 1 -10). Don't forget to save program.

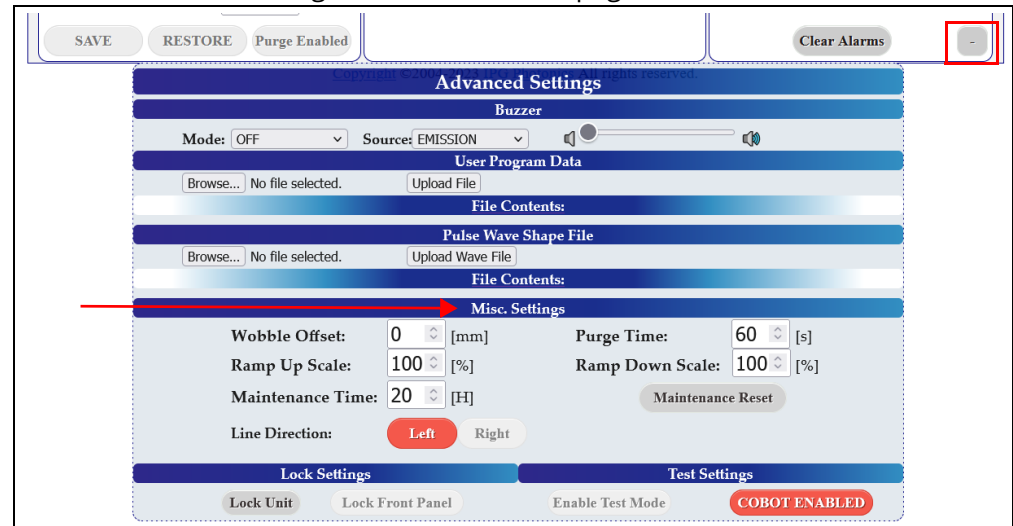
▼ Figure 57. Advanced Feature - Uploading Example User Pulse Wave Shapes



9.10 Configure Misc. Settings - Advanced Settings

For instructions on accessing the device webpage refer to section 9.3 [▶131].

1. Click the + button on the bottom right of the main user webpage to expand the Advanced Settings section of the webpage.



2. Go to **Misc. Settings** section under Advanced Settings, set the **Wobble Offset**.
 - The wobble offset is along the same axis as the beam wobble and is used to center the beam when using the wire feeder.
 - Wobble offset must be a value within the limit of +/- 3 mm. Default value is 0 mm (no offset).
3. Go to **Misc. Settings** section under Advanced Settings, set the **Ramp Up Scale**. Then set the **Ramp Down Scale**. Refer to Table 34 [▶145].
 - This sets global scale factors that will be applied to all user and preset program ramp up time and ramp down time settings. This only applies to programs that are configured to use either CW or STITCH laser mode.
 - Scale values must be within limit of 10-200%. Default value is 100%. Refer to table below that illustrates how the ramp scale will be applied. These examples assume the program ramp time being scaled is 1000 ms.

▼ Table 34. Effects of Ramp Up Scale and Ramp Down Scale

Program Ramp Time	Ramp Up Scale / Ramp Down Scale	Scale Factor Applied to Set Ramp Time	Actual Ramp Up Time / Ramp Down Time
1000 ms	10%	0.1 x	100 ms
1000 ms	100% (Default)	1 x	1000 ms
1000 ms	200%	2 x	2000 ms

4. Go to **Misc. Settings** section under Advanced Settings, set the **Purge Time**.
 - Purge gas will turn on after user finishes welding, and only stay on for a set time (it will also turn on for the set time once after power up). In earlier firmware releases the purge gas was always on or always off. To prevent excess gas usage, this purge time setting was implemented.

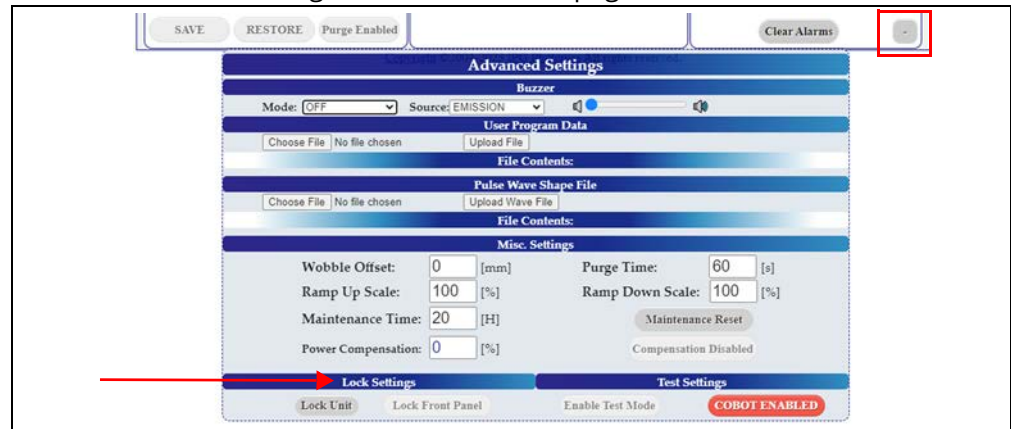
- The range of the purge time setting is 0 to 998 seconds, with a default value of 60 seconds. Setting the purge time to 999 will keep purge gas on infinitely (replicating legacy operation from older firmware).
- 5. Go to **Misc. Settings** section under Advanced Settings, set the **Maintenance Time** interval (in emission on hours).
 - This feature tracks the number of emission on hours since the last time this timer was cleared. The **OptX** device will generate a warning when the number of hours exceeds the interval threshold set here.
 - The Maintenance warning indicator will be lit once the total emission on hours exceeds the set threshold. To clear the warning and reset the timer, click the **Maintenance Reset** button.

Procedure is complete.

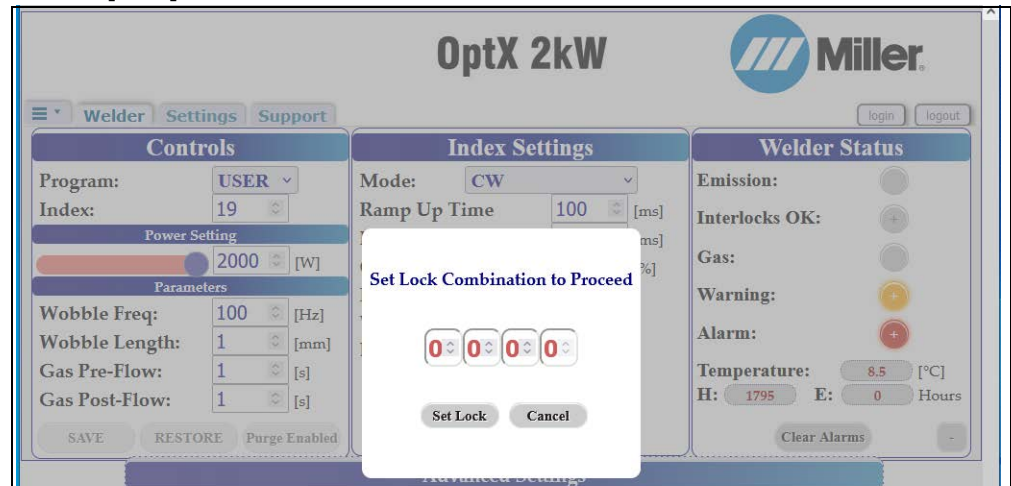
9.11 Reseller Setting Lock Unit - Advanced Settings

For instructions on accessing the device webpage refer to section 9.3 [▶131].

1. Click the + button on the bottom right of the main user webpage to expand the Advanced Settings section of the webpage.



2. Go to **Lock Settings** section under Advanced Settings and click **Lock Unit**.
 - User will be asked to input the 4 digit activation code and then click **Set Lock** button to confirm the lock. This is the code that was provided to user after successful completion of the Miller safety webinar. Once locked the unit cannot be used and must be unlocked again. Refer to section 2.10 [▶59].

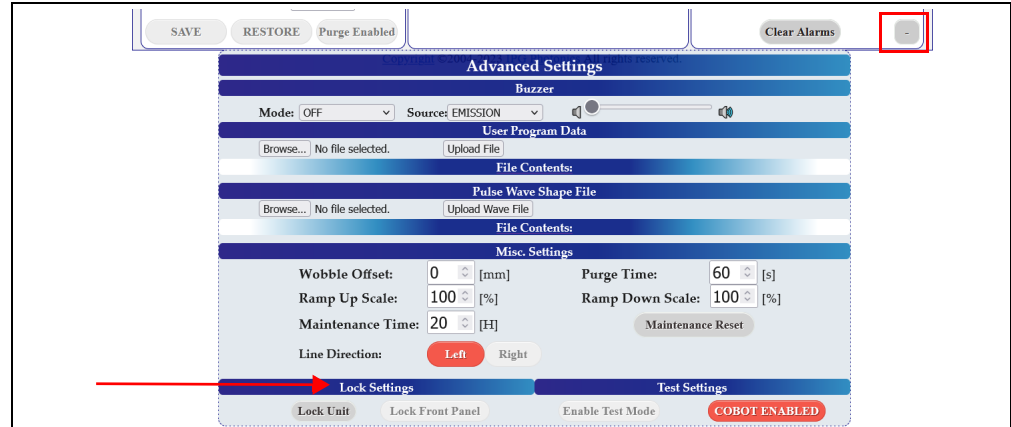


Procedure is complete.

9.12 Locking Device Front Panel Controls

For instructions on accessing the device webpage refer to section 9.3 [▶131].

1. Click the + button on the bottom right of the main user webpage to expand the Advanced Settings section of the webpage.



2. Go to **Lock Settings** section under Advanced Settings and click **Lock Front Panel** button.
 - Locking the front panel means that the rotary knobs for Laser Power, Wobble Frequency and Wobble Length will be disabled. The welder operator will not be able to change these weld program settings.
 - The only controls that will remain operational will be the Program Mode selection buttons. The front panel indicator lights will also continue to function.

Procedure is complete.

9.13 Test Settings - Advanced Settings

Test Mode is used by advanced users for testing and calibration purposes. Special tools, meter and/or fixtures are required. Contact Miller Customer Support for more information on using this mode.



IMPORTANT

Class 4 invisible radiation during Test Mode. Eye and skin hazard.

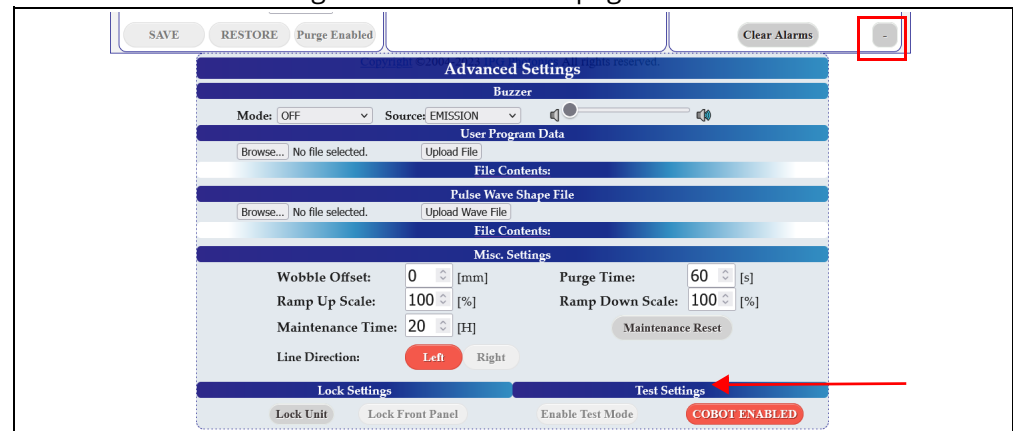
Enabling Test Mode will temporarily disable some of the safety features for one emission cycle. Exposure to this level of light can cause severe eye or skin damage. Also risk of severe and permanent eye damage from reflected or scattered radiation.

- NEVER point the handheld torch in the direction of any individual's head or body parts.
- All persons in the Laser Controlled Area must wear the combination of (1) the specified laser safety eyewear, and (2) laser welding helmet with appropriate filters (for UV and visible radiation) and face shield will offer the best protection.

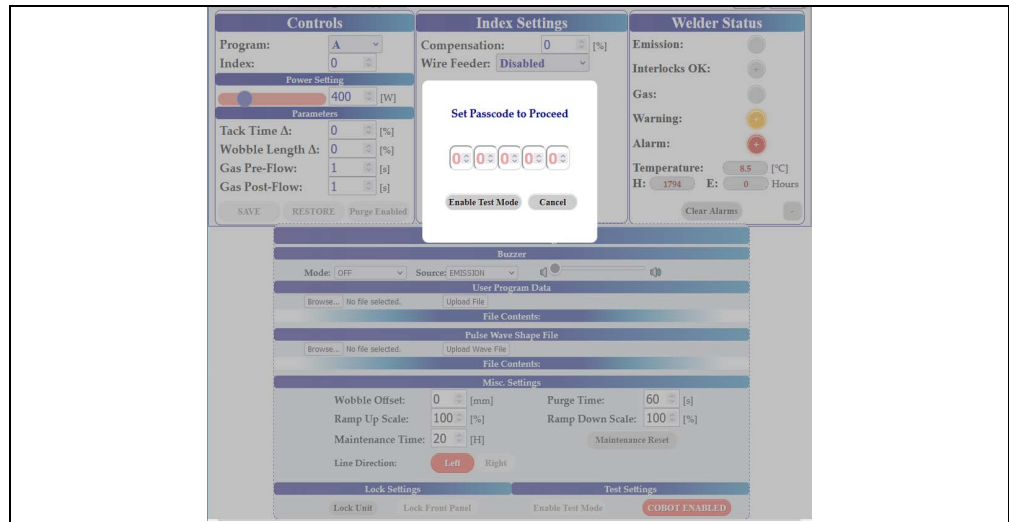
- To use Test Mode the Nozzle Interlock must first be satisfied. Any attempt to enable Test Mode without Nozzle Interlock satisfied will result in an error.
- Test Mode will automatically be disabled after one emission cycle completes or as soon as the Nozzle Interlock is no longer satisfied.
- Note that Test Mode ignores the presence of gas (or lack thereof) and plasma detection as a safety check, but it still needs all interlocks closed for emission to turn on.

For instructions on accessing the device webpage refer to section 9.3 [▶131].

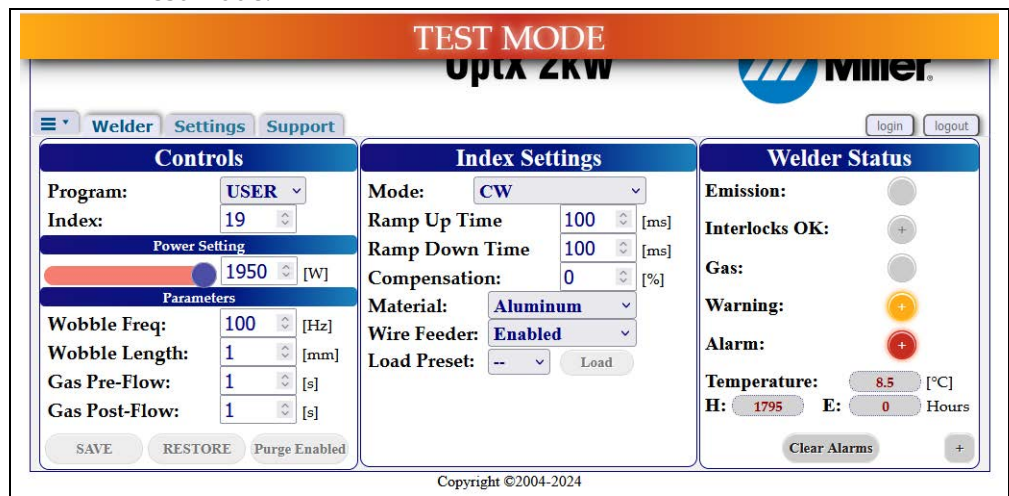
1. Click the + button on the bottom right of the main user webpage to expand the Advanced Settings section of the webpage.



2. Go to **Test Settings** section under Advanced Settings and click **Enable Test Mode** button.
 - User will be asked to input a 5 digit code. Click the **Enable Test Mode** button to switch to Test Mode.



- Banner at the top of the webpage will indicate that laser device is operating in Test Mode.



- Operator must press the Trigger 1 switch followed by Trigger 2 switch to turn the emission on. After one emission cycle, Test Mode is automatically disabled.

Procedure is complete.

10 Troubleshooting

If an alarm occurs the Error status indicator on the front panel of the device will be lit red. There are 32 possible alarms. To determine which alarm bit(s) caused a particular error:

- Check the Laser Power display on the front panel. The error code will be shown on that display and will begin with the letters “Er” followed by a two digit number (e.g. **Er03** for alarm bit-3).
- Alternatively, users may view alarm status bits through the **Welder** web page interface. Refer to section 9.4 [▶132].

For a description of the alarms and methods for clearing them, refer to Table 35 [▶151]. Many of the alarms can be cleared in one of three ways.

1. **Trigger 1 Control on Torch:** Release both Trigger 2 (if pressed) and Trigger 1 controls and re-press Trigger 1 again. Once Trigger 1 is pressed, the first thing it will do is to try to clear any alarms automatically. As long as the condition that caused it was resolved, the error should clear.
2. **Clear Alarms:** Users may also clear any errors through the **Welder** web page by clicking the “Clear Alarms” button. Refer to section 9.4.1 [▶133].
3. **Reboot Using Keyswitch:** A small subset of these alarms can only be cleared by rebooting the unit. If the condition that caused it was not resolved, the alarm is likely to occur again. If this is the case, contact Miller Service for assistance.

IMPORTANT

- For the front panel error display, the severity of the alarms increases with increasing error numbers. Er27 is more severe than Er01.
- If more than one type of alarm has occurred, the alarm number with the higher severity will be displayed on the front panel. However if using the web page interface, the web page alarm indicator lights will show all the error alarms that occurred.

▼ Table 35. Welder Status Alarms Bit Table

Code	Type of Alarm	Description	How to Clear Error?
Er00	-----	Reserved	-----
Er01	Galvo Position	Beam wobble control reported laser beam position error. Laser beam did not go to commanded position.	Trigger 1 Control or “Clear Alarms”
Er02	Under Temp	The laser module temperature is below the minimum temperature threshold for operation. To view the laser’s temperature reading, go to the Welder web page and check Welder Status Temperature (refer to section 9.4 [▶132]).	Wait until case Temperature is greater than 8.5°C (47°F) then clear with either Trigger 1 Control or “Clear Alarms”

▼ Table 35. Welder Status Alarms Bit Table (Continued)

Code	Type of Alarm	Description	How to Clear Error?
Er03	Over Temp	The laser module temperature has exceeded normal operating temperature (>55°C). If this occurs during welding, laser emission will turn OFF automatically. To view the laser's temperature reading, go to the Welder web page and check Welder Status Temperature (refer to section 9.4 [▶ 132]).	Wait until case Temperature has cooled down below warning threshold of 52°C (125°F) then clear by Trigger 1 Control or "Clear Alarms"
Er04	No Plasma	Plasma detection feature did not detect plasma during welding. There are 2 independent conditions that can cause this: 1. Normal- No plasma detected during welding (light detected was below material threshold). 2. Ambient- Ambient light surrounding the material is interfering with the plasma detector operation. This is always paired with the Ambient Light Warning. If Ambient Light Warning is active with Er04, then error was due to ambient. Refer to Table 31 [▶ 133] #4.	Trigger 1 Control or "Clear Alarms"
Er05	-----	Reserved	-----
Er06	Fiber Fuse 1	First Internal fiber fuse photodiode reading exceeded the maximum allowable threshold (there is too much power in the external fiber). This is a critical error that must be addressed. Contact Miller for assistance.	Trigger 1 Control or "Clear Alarms"
Er07	Fiber Fuse 2	Second Internal fiber fuse photodiode reading exceeded the maximum allowable threshold (there is too much power in the internal fiber). This is a critical error that must be addressed. Contact Miller for assistance.	Trigger 1 Control or "Clear Alarms"
Er08	Back Reflection	Internal back reflection photodiode reading exceeded its threshold. Light is reflecting back into fiber.	Trigger 1 Control or "Clear Alarms"
Er09	Under Power	Actual laser power is less than set point.	Trigger 1 Control or "Clear Alarms"
Er10	Over Power	Actual laser power is greater than set point.	Trigger 1 Control or "Clear Alarms"

▼ Table 35. Welder Status Alarms Bit Table (Continued)

Code	Type of Alarm	Description	How to Clear Error?
Er11	Interlock Malfunction	Malfunctioning Interlock Safety Loop. Monitors key signals, remote start and "all safe" signals.	Power off and on the unit with the keyswitch, E-Stop or AC power cord.
Er12	Fiber Interlock	Malfunctioning fiber interlock safety loop. Check fiber cable connection to torch. Disconnect and reconnect the fiber into the torch.	If fiber interlock opens up then Trigger 1 Control or "Clear Alarms" will clear error.
Er13	External Interlock	External A and External B (pins 1,2 and 3,4 on 12-pin connector) interlock state does not match. This indicates that one channel opened while the other one stayed closed.	Both Ext A and Ext B interlocks must both be open before Trigger 1 Control or "Clear Alarms" will clear error.
Er14	PS Enable	On system startup, the laser power supply was in the enabled state	Power off and on the unit with the keyswitch, E-Stop or AC power cord.
Er15	Startup Diagnostic	One or more safety signals powered up into incorrect state. Monitors fiber interlock signals, remote start and "all safe" signals on startup.	Power off and on the unit with the keyswitch, E-Stop or AC power cord.
Er16	Power B Disable	Power supply was enabled before rising edge of emission on.	Power off and on the unit with the keyswitch, E-Stop or AC power cord.
Er17	Power A Disable	On rising edge of emission on signal, laser power supply enable was not on.	Power off and on the unit with the keyswitch, E-Stop or AC power cord.
Er18	External B Shutdown	While emission was ON, external interlock B (pins 3, 4 on the 12-pin interface connector) opened unexpectedly so the laser was shutdown.	Trigger 1 Control or "Clear Alarms"
Er19	External A Shutdown	While emission was ON, external interlock A (pins 1, 2 on the 12-pin interface connector) opened unexpectedly so the laser was shutdown.	Trigger 1 Control or "Clear Alarms"
Er20	Fiber Interlock Shutdown	While emission was ON, the fiber interlock opened which resulted in the laser being shutdown. Check fiber cable to torch connection.	Trigger 1 Control or "Clear Alarms"
Er21	Nozzle Shutdown	While emission was ON, the nozzle to Work Sense clamp interlock opened which resulted in the laser being shutdown (e.g. During welding the operator lifted nozzle off part while still pressing Trigger 2).	Trigger 1 Control or "Clear Alarms"

▼ Table 35. Welder Status Alarms Bit Table (Continued)

Code	Type of Alarm	Description	How to Clear Error?
Er22	Trigger 1 Shutdown	While emission was ON, the Trigger 1 interlock opened which resulted in the laser being shutdown (e.g. During welding the operator released the Trigger 1 gas control on the torch).	Trigger 1 Control or "Clear Alarms"
Er23	PS Voltage	On the rising edge of emission ON, detected that the laser power supply was not regulating the voltage properly.	Trigger 1 Control or "Clear Alarms"
Er24	PS Current	While emission was ON, detected that the laser power supply was not regulating current properly.	Trigger 1 Control or "Clear Alarms"
Er25	Nozzle Startup	On system power up via keyswitch, E-Stop, or AC power the nozzle interlock was closed.	Open nozzle interlock (e.g. lift nozzle off part) then clear by Trigger 1 Control or "Clear Alarms"
Er26	Trigger 1 Startup	On system power up via keyswitch, E-Stop, or AC power the Trigger 1 interlock was closed.	Open Trigger 1 interlock (e.g. release Trigger 1 Control on Torch) then clear by Trigger 1 Control or "Clear Alarms"
Er27	Thermal Shutdown	The system's optical or electrical model determined the laser diodes were going to overheat.	Wait until the model(s) have cooled to a safe operating temperature with emission OFF then use Trigger 1 Control or "Clear Alarms"
Er28	Nozzle Reset	Emission has occurred 25 times without the nozzle interlock opening up.	Open Nozzle interlock (e.g. lift the nozzle off the part) then clear by Trigger 1 Control or "Clear Alarms"
Er29	Trigger 1 Reset	Emission has occurred 25 times without the Trigger 1 interlock opening up.	Open Trigger 1 interlock (e.g. release Trigger 1 Control on Torch) then clear by Trigger 1 Control or "Clear Alarms"
Er30	Gas Shutdown	Gas pressure was not detected while emission was ON or the laser tried to fire before gas delay was met.	Trigger 1 Control or "Clear Alarms"
Er31	Fan Alarm	Either fan was not detected spinning, checks continuously after 30 second startup delay.	Trigger 1 Control or "Clear Alarms" once fans resume spinning.

A Maintenance

! WARNING



ELECTRIC SHOCK can kill

Touching live electrical parts can cause fatal shocks or severe burns. The input power circuit and machine internal circuits are also live when power is on. Incorrectly installed or improperly grounded equipment is a hazard.

! WARNING



Invisible class 4 laser radiation when the OptX device is energized

Risk of permanent skin or eye damage and vision impairment from invisible direct, reflected, and scattered Class 4 laser radiation during maintenance.

- Shut off the **OptX** device (section 5.10 [▶ 91](#)).
- Remove the AC power connection.
- Secure the device against being switched on again.

A.1 Torch Maintenance

Personnel Qualifications: Maintenance Personnel (see section 1.4 [▶ 18](#)).

▼ Table 36. Recommended Maintenance and Intervals

What Item	Interval	Type of Maintenance
Nozzle Tip	Daily	Regular inspection for contamination. Cleaning, if contaminated.
Protective Window	Daily	Regular inspection of the protective window for contamination and timely replacement, if contaminated. Follow procedure in section A.1.1 ▶ 156 which describes the steps for disassembling and replacing this window if needed.
Focus Lens	Daily	Regular inspection of the focus lens for contamination and timely replacement, if contaminated. Follow procedure in section A.1.2 ▶ 158 which describes the steps for disassembling and replacing this lens if needed.
Fiber Cable	Daily	Daily visual inspection of yellow fiber cable for damage.
QBH Connection	Every 3 days	Regular inspection of QBH connector for looseness.
Trigger 1 & 2 Switches	3.2 years	The torch trigger switches should be replaced every 3.2* years. *Refer to section A.1.3 ▶ 159 .

▼ Table 37. List of Field Replaceable Parts

Miller Part Number	Quantity	Description
301823 (5 Pack)	1	Protective Window Replacement Kit (Only need one protective window for this procedure)
296267	1	OptX Focus Lens
296575	1	OptX Torch

A.1.1 Protective Window Replacement

This procedure is applicable for all models. The protective window must always be clean and checked regularly.

NOTICE

Torch maintenance precaution

Torch can become damaged if maintenance is performed while AC power is ON.

- Prior to performing any kind of maintenance on the handheld torch, maintenance personnel should (1) shut off the unit (section 5.10 [▶ 91]) and (2) remove AC power connection.

NOTICE

Installing protective window from other suppliers

This can damage the torch. This will also alter the specifications and performance of the device.

- For safe and reliable operation only use an Miller supplied protective window. Only the Miller protective window will have the correct specifications and coating specifically designed to work with the laser inside the device.

NOTICE

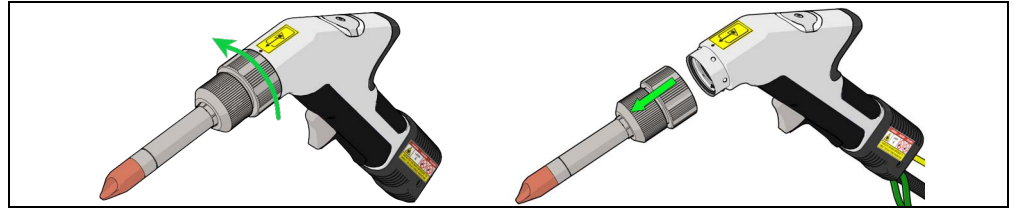
Handle the Delicate protective window with care

Contamination or scratches on the protective window degrades the laser welding process. This can eventually crack the window and can damage the torch.

- Wear nitrile gloves. Avoid touching the flat surface of the protective window.
- Do NOT use tweezers or other tools (can scratch the coating on the window).
- Carefully pick up (or place) the protective window by its edge.

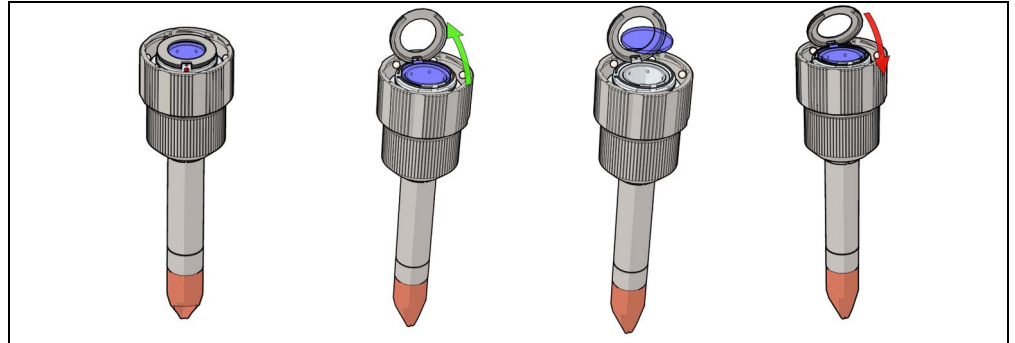
4. On the torch, turn the silver collet chuck counterclockwise to disengage window/nozzle assembly (Figure 58 [▶ 157]).

▼ **Figure 58.** *Disengaging Window/Nozzle Assembly*



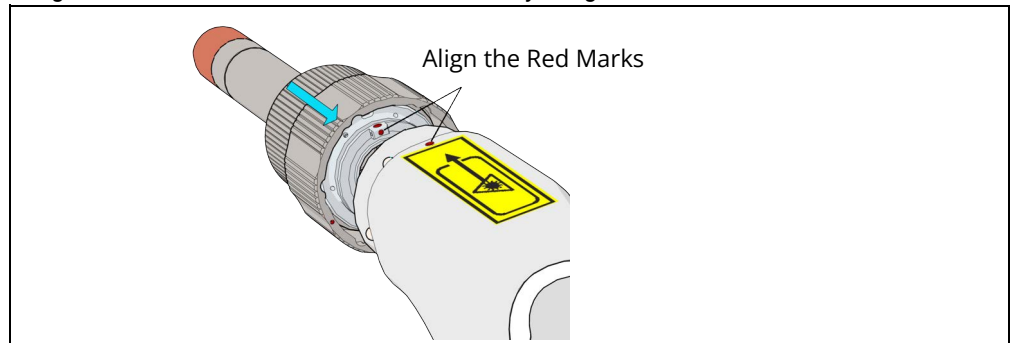
5. Flip open the cap to access the protective window underneath. Users should inspect the new protective window for contamination prior to installing it. Use CDA to blow any dust or debris off the new protective window. Replace the protective window and securely close cap (Figure 59 [▶ 157]).

▼ **Figure 59.** *Accessing Protective Window*



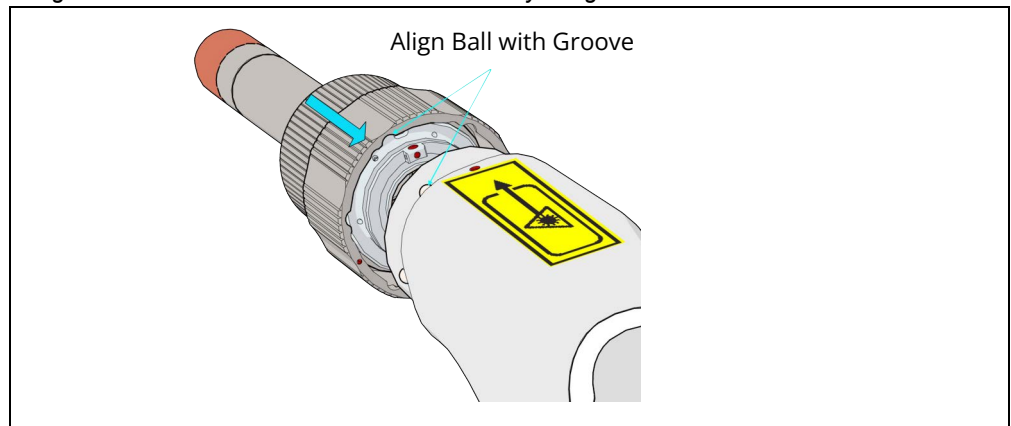
6. To reattach window/nozzle assembly:
 - ▶ Align the red marks (Figure 60 [▶ 157]).

▼ **Figure 60.** *Reattach window/nozzle assembly - Align the Red Marks*



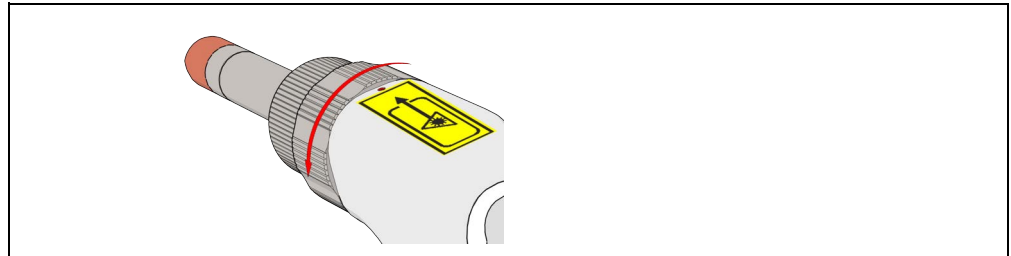
- ▶ Align balls with circular cutouts (Figure 61 [▶ 158]).

▼ Figure 61. Reattach window/nozzle assembly - Align Balls with Circular Cutouts



- Rotate the collet chuck as shown to lock the assembly in place (Figure 62 [▶ 158]).

▼ Figure 62. Reattach window/nozzle assembly - Turn Collet Chuck to Lock Assembly

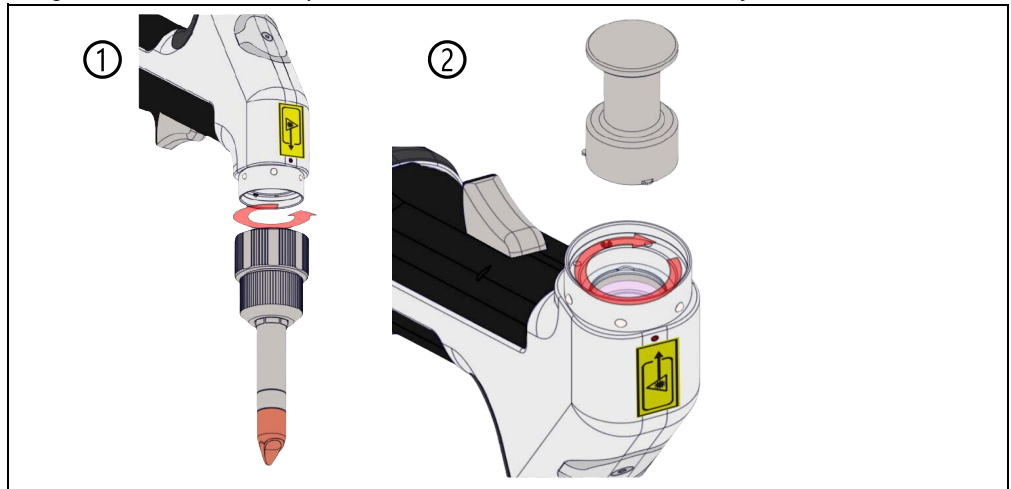


End of Procedure

A.1.2 Focus Lens Replacement

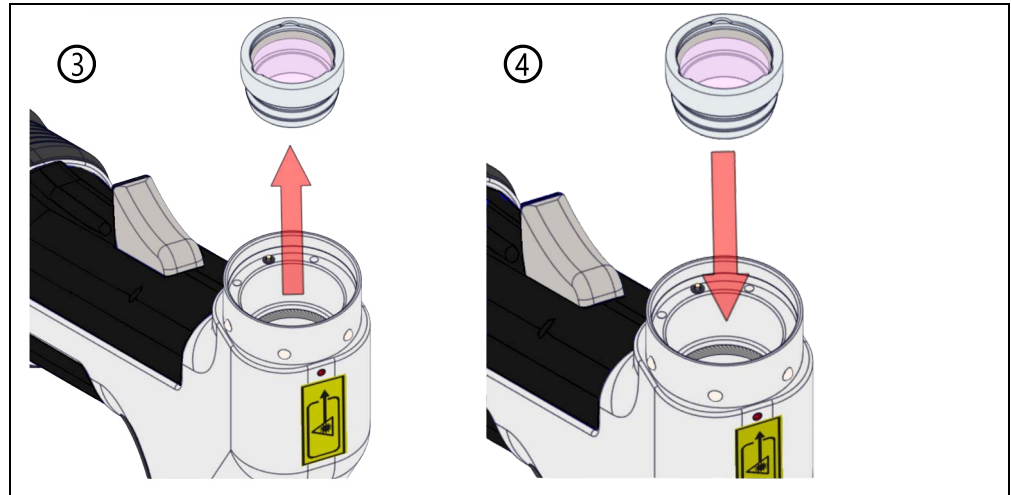
1. Twist and remove the nozzle assembly. See Figure 63 [▶ 158].
2. Insert the Lens Cell Removal tool (296263). See Figure 63 [▶ 158].

▼ Figure 63. Lens Cell Replacement - Remove the nozzle assembly and insert tool



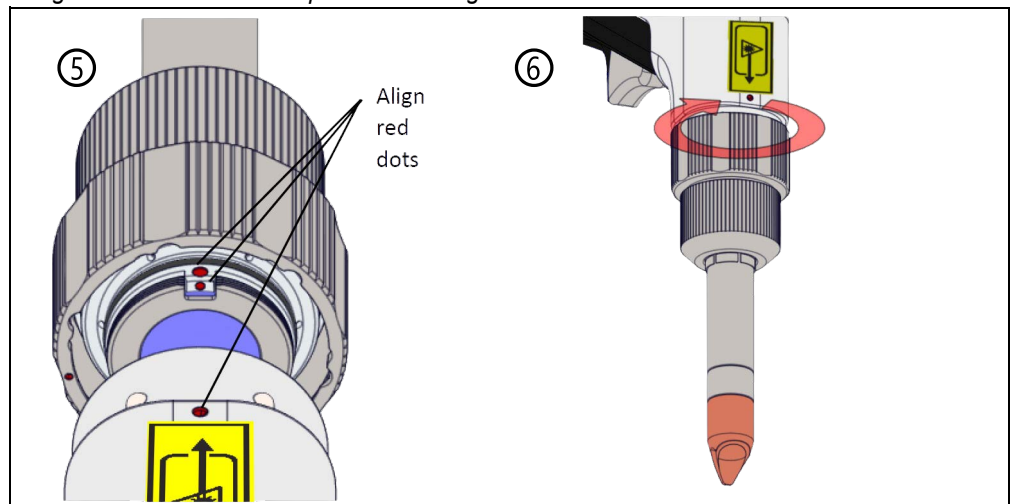
3. Using the tool, pull out the damaged lens cell. See Figure 64 [▶ 159].
4. Using the tool, carefully insert the new lens cell (296267). Push to make sure the lens is properly seated. See Figure 64 [▶ 159].

▼ Figure 64. Lens Cell Replacement - Pull out damaged Lens Cell and Replace



5. Align the red dots on the nozzle assembly with the red dot on the head. See Figure 65 [▶ 159].
6. Push the nozzle assembly over the ball bearings and twist to lock in place. See Figure 65 [▶ 159].

▼ Figure 65. Lens Cell Replacement - Align the Red Dots and Twist to Lock



End of Procedure

A.1.3 Wearing of Safety-Related Components

NOTICE

Replacement of safety-related components

An n_{op} value is provided for wearing safety-related components (median value of annual component actuations as per EN ISO 13849-1). If the actual median value of annual component actuations exceeds this value, the time T_{10d} must be ascertained as per EN ISO 13849-1. Dependent on this, the safety-relevant component must be prematurely replaced.

▼ Table 38. Torch Trigger Switch Replacement

Test Point	Trigger Switches in Torch
Remedy	Replace the trigger switches
Time Interval	At $n_{op} = 125000$ cycles/year replace at 3.2 years. ($B_{10d} = 4 \times 10^5$) or in the event of defects.
Item	Handheld Laser Torch
Description	Contact local Miller Service to have the torch returned for switch replacement or exchanged (refer to section B.1 [▶ 169]).

The replacement of the torch switches is only to be performed by Miller service personnel.

A.1.4 Replacing the Torch

Personnel Qualifications: Maintenance Personnel (see section 1.4 [▶ 18]).

NOTICE

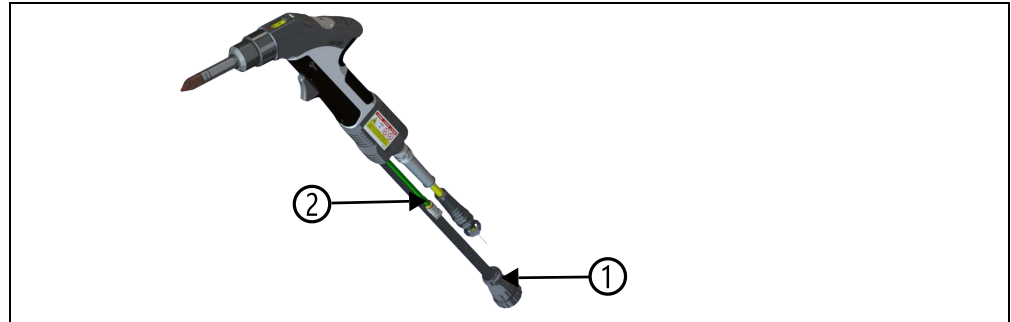
Torch maintenance precaution

Torch can become damaged if maintenance is performed while AC power is ON.

- ▶ Prior to performing any kind of maintenance on the handheld torch, maintenance personnel should (1) shut off the unit (section 5.10 [▶ 91]) and (2) remove AC power connection.
1. Unpack the new torch and make sure to prepare it to receive the fiber bayonet. Place it on table nearby.
 2. Remove the AC power cord from the system and turn off the gas supply.
 3. From the bottom of the torch, remove approximately 0.5 m (1.5 ft) of the netted sheathing from the umbilical cable to expose the cabling within.
 4. Disconnect the electrical cable (see Figure 66 [▶ 161], #1).
 - ▶ Rotate the connector counter clockwise and pull to disconnect.
 5. Disconnect the gas tubing (see Figure 66 [▶ 161], #2).
 - ▶ Press in fitting to remove tubing.
 6. Remove the boot and disconnect the fiber output bayonet from the bottom of the torch.
 - ▶ Refer to section A.2 [▶ 161] for instructions on how to do this.
 7. Once the bayonet is removed, and to maintain cleanliness, immediately connect the fiber output bayonet to the new head.
 - ▶ Refer to section A.2 [▶ 161] for instructions on how to connect bayonet to the new torch.
 8. Once the bayonet is connected, re-install the boot.
 9. Reconnect the electrical cable.
 - ▶ Check the orientation of the plug and plug into other connector. Rotate connector to lock in place.
 10. Reconnect the gas tubing.

11. Re-install the netted sheathing that was removed from the umbilical cable in step 3.
12. Turn on gas supply.
13. Power up the welding system.

▼ Figure 66. Disconnecting Torch



Item	Designation	Item	Designation
1	Electrical Connection	2	Gas Tubing Connection

A.2 Connect/Disconnect Fiber Output

Personnel Qualifications: Maintenance Personnel (see section 1.4 [▶ 18]).

The following procedures to disconnect and connect the fiber output to the torch should only be necessary when replacing the output torch. During normal operation, this does not need to be performed. Prior to reconnecting the fiber to the torch, the cleaning procedure (section A.3 [▶ 165]) must also be performed.

A.2.1 Precautions for Fiber Maintenance Procedures

NOTICE

Torch maintenance precaution

Torch can become damaged if maintenance is performed while AC power is ON.

- ▶ Prior to performing any kind of maintenance on the handheld torch, maintenance personnel should (1) shut off the unit (section 5.10 [▶ 91]) and (2) remove AC power connection.

NOTICE

Fiber cable terminator contamination

The quartz block is very delicate and must stay perfectly clean. Any contamination will result in serious damage to the fiber cable. See section 3.6 [▶ 72].

- ▶ Always wear clean nitrile gloves when disconnecting fiber from torch.
- ▶ NEVER touch the quartz block at the end of the fiber connector.
- ▶ Only remove fiber from torch when necessary for replacement.
- ▶ Always follow instructions in this section.

NOTICE**Fiber cable terminator contamination**

The quartz block is very delicate and must stay perfectly clean. Any contamination will result in serious damage to the fiber cable. See section 3.6 [▶ 72].

- ▶ Always wear clean nitrile gloves when disconnecting fiber from torch.
- ▶ NEVER touch the quartz block at the end of the fiber connector.
- ▶ Only remove fiber from torch when necessary for replacement.
- ▶ Always follow instructions in this section.

NOTICE**Laser fiber cable handling**

Severe laser damage will occur if optical fiber cable, routed through the umbilical, is mishandled (extreme bending, pulling or impact).

- ▶ Do not bend the yellow optical fiber cable to a radius less than 50 mm minimum bending radius.
- ▶ Do not apply excessive load or impact to the fiber cable.
- ▶ NEVER move or lift the unit by pulling or dragging on the umbilical cabling.

A.2.2 Disconnect Fiber Output

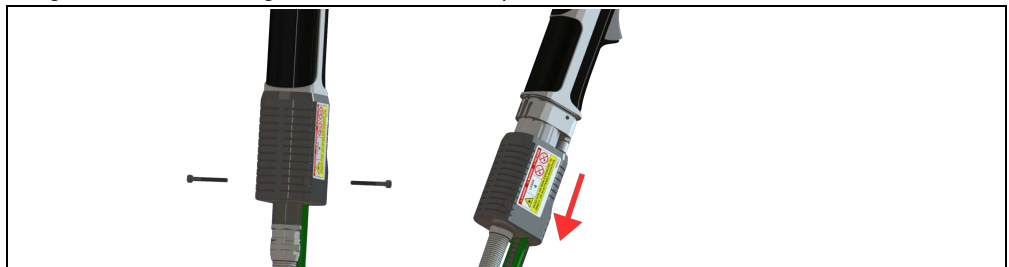
IMPORTANT

Must read and follow precautions in section A.2.1 [▶ 161] before beginning this procedure.

The output fiber connection is within the boot section of the torch.

1. Remove power from device.
2. To remove the boot, unscrew the 2 SHCS shown here and pull down the boot (Figure 67 [▶ 162]).

▼ Figure 67. Removing boot from torch to expose fiber connector



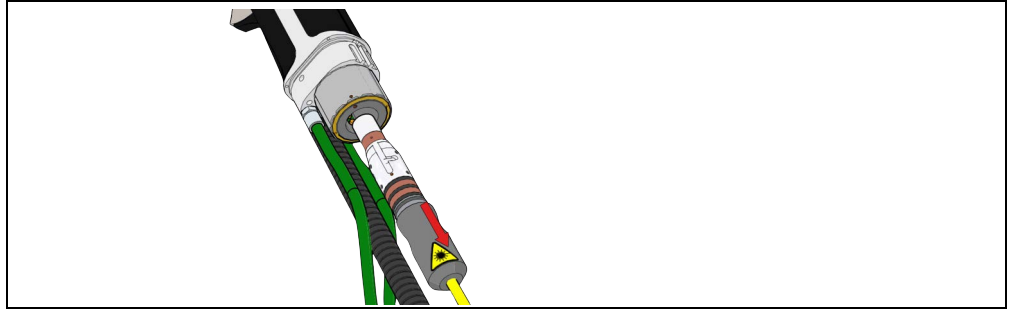
3. Rotate receiver nut to align red dots as indicated in drawing below (Figure 68 [▶ 162]).

▼ Figure 68. Rotate receiver nut to align red dots



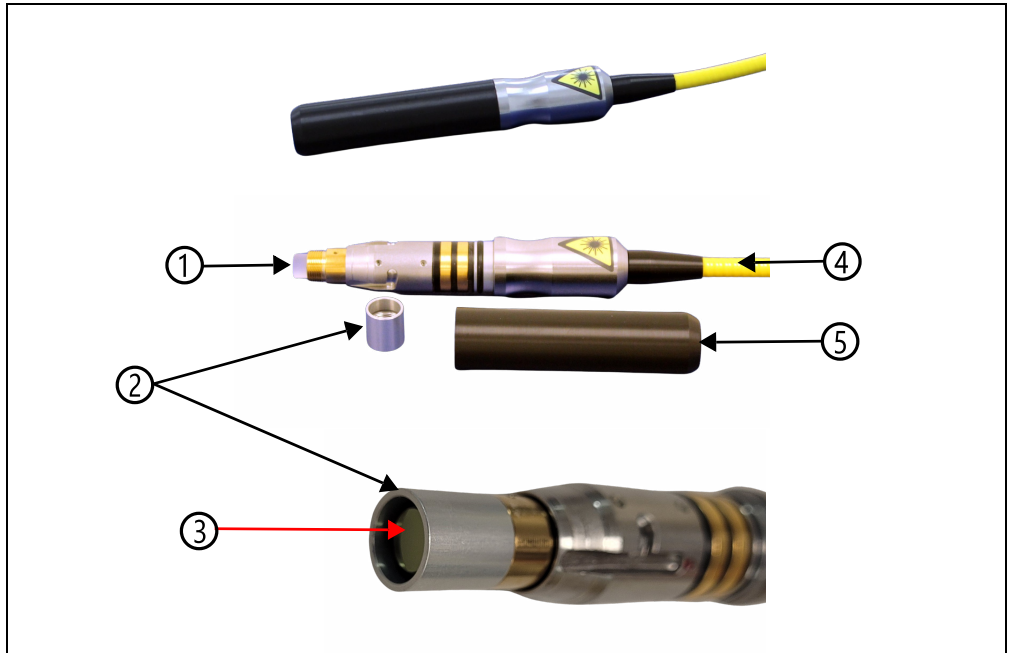
4. Carefully pull out the fiber connector (Figure 69 [▶ 163]).

▼ Figure 69. Pulling out fiber connector from torch



5. Leave protective cap installed over quartz block. Install storage sleeve. Never touch the protective cap window or quartz block optical surfaces. These surfaces must remain clean.
6. Close the welding head with a protective cap.

▼ Figure 70. Fiber End Connector with Protective Cap and Sleeve



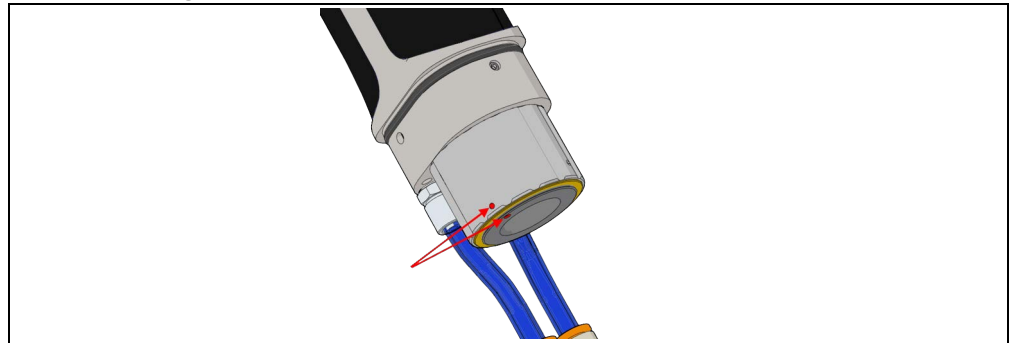
Item	Designation	Item	Designation
1	Quartz Block	2	Protective Cap
3	Protective Cap Window	4	Fiber
5	Cap, Protective, Fiber Optic Outlet (#296303)	--	--

A.2.3 Connecting Fiber Cable to Torch

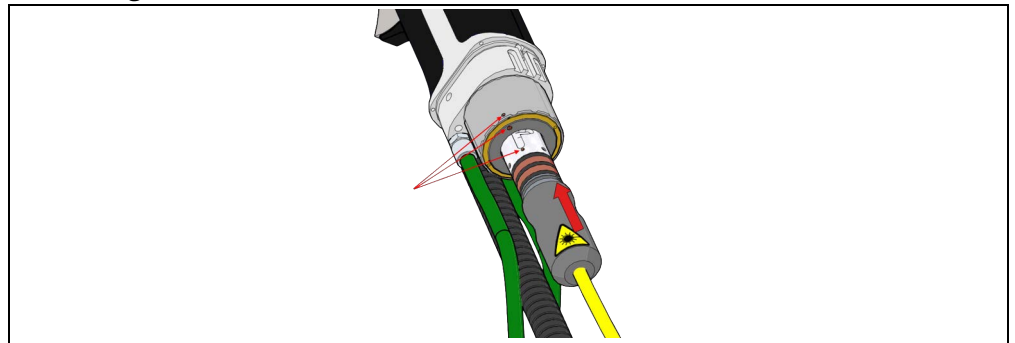
IMPORTANT

Must read and follow precautions in section A.2.1 [[▶161](#)] before beginning this procedure.

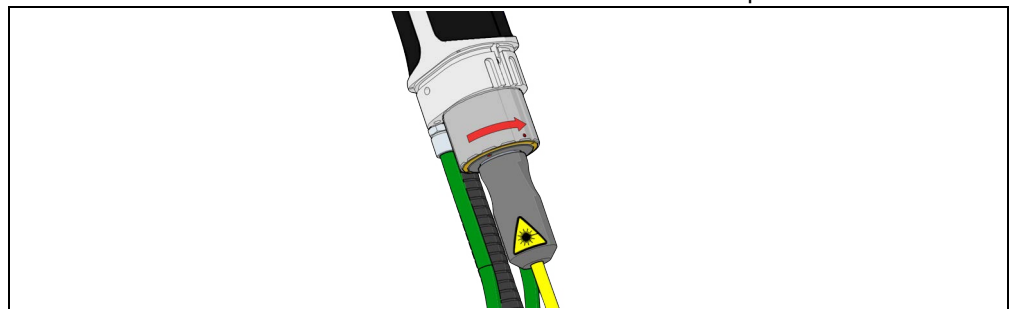
1. Remove power from the device.
2. Before reconnecting the fiber to the torch, the technician must first perform the cleaning procedure (section A.3 [[▶165](#)]) on the fiber output quartz block.
3. Remove storage sleeve from fiber bayonet. Leave protective cap on quartz block.
4. To reconnect the fiber output connector, ensure the red dots on the receiver nut are aligned as shown.



5. Insert the fiber by aligning the red dot on the fiber output connector with the red dots on the receiver as shown. Insert the fiber output connector as far as it will go but do not force it.



6. Rotate receiver nut as shown to lock fiber connector in place.



7. Reinstall and secure the torch boot. Do not operate the torch with the boot not secured in place (see pictures in section A.2.2 [[▶162](#)]).

End of Procedure

A.3 Output Termination Cleaning Procedure

Personnel Qualifications: Maintenance Personnel (see section 1.4 [▶18]).

It is imperative that a fiber termination is checked for dust, dirt or damage every time the fiber output connection to the torch is disconnected.

NOTICE

Fiber cable terminator contamination

The quartz block is very delicate and must stay perfectly clean. Any contamination will result in serious damage to the fiber cable and welding head. See section 3.6 [▶72].

- ▶ Always wear clean nitrile gloves when disconnecting fiber from torch.
- ▶ NEVER touch the quartz block at the end of the fiber connector.
- ▶ Only remove fiber from torch when necessary for replacement.
- ▶ Always follow instructions in this section.

NOTICE

- ▶ The use of a dirty or improperly cleaned output fiber termination can lead to serious damage to the unit. Miller is not responsible for any damages due to contaminated output fiber termination. Custom fiber terminations may require a different procedure.

A.3.1 Recommended Cleaning Supplies

NOTICE

Torch maintenance precaution

Torch can become damaged if maintenance is performed while AC power is ON.

- ▶ Prior to performing any kind of maintenance on the handheld torch, maintenance personnel should (1) shut off the unit (section 5.10 [▶91]) and (2) remove AC power connection.

The following items are recommended for cleaning the output termination:

- Powder free rubber gloves or finger cots
- Optical cleaning wipes and/or swabs
- Lens tissue
- Isopropanol (water free)
- Acetone (optical grade, water free)
- Compressed air (oil free, water free)
- Microscope (Miller model or equivalent) or 20X Eye Loupe
- Light Source

▼ Figure 71. Recommended Cleaning Supplies (not included)



A.3.2 Cleaning the Quartz Block (Generic Procedure)

IMPORTANT

It is imperative that you wear powder free rubber gloves during this cleaning procedure.

Perform the following procedure to clean the fiber output termination:

1. Turn off in the welder unit and remove power from the device (section 5.10 [▶91]).
2. Spray the quartz block end face with Isopropyl Alcohol. Wipe it with a new sheet of lens tissue and blow the surface with clean compressed air.
3. Inspect the end face surface with the microscope.
4. Use light source to illuminate the end face of the fiber termination so that the light is reflected from the surface.

IMPORTANT

Always look at the surface at a slight angle to improve visibility.

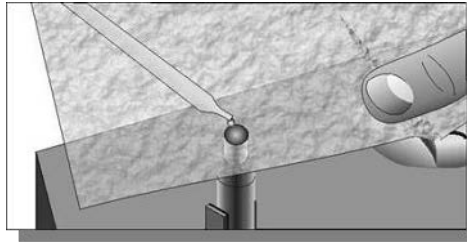
5. Inspect the surface carefully. If contamination is visible on the quartz block, cleaning is necessary. Contamination will lead to dark spots on the surface.
6. Try to blow off the dust with compressed air from the side.

IMPORTANT

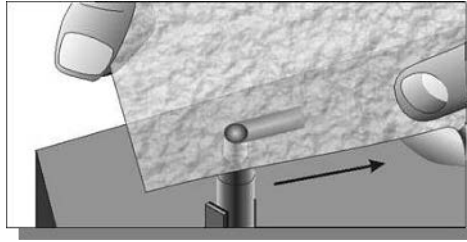
Never blow air directly at the surface because you might embed contaminants into the surface. Always blow across the surface being cleaned.

7. Place a new sheet of lens tissue on the surface of the quartz block as shown in the picture below. Put one drop of Isopropanol onto the lens tissue and wipe the wet spot laterally across the surface until it is dry.

▼ Figure 72. Isopropanol on lens tissue



▼ Figure 73. Lateral wipe across surface



IMPORTANT

Do not let the areas where your fingers have touched the tissue come into contact with the surface being cleaned.

8. Re-inspect the surface
9. Repeat step 7 with Acetone if it is still contaminated.
10. If necessary you should put a drop of acetone onto a cleaning swab and wipe away contamination in a circular motion, do not scratch the surface.

IMPORTANT

- Do not touch the tip of the cleaning swab with your fingers.
- To prevent contamination, only use each swab once.

11. Repeat above cleaning steps until all contamination is removed. This cleaning procedure can be stopped at any time if a good result has already been achieved.

IMPORTANT

It is hereby stated that damage to the fiber termination can occur due to mishandling; the use of incorrect cleaning procedures or chemicals for cleaning and is not covered by the warranty.

End of Procedure

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B Service and Support

There are no operator serviceable parts inside. Refer all servicing to qualified Miller personnel.

B.1 Technical Support

Many issues and questions regarding the safety, set-up, operation and maintenance of the Miller products can be resolved by carefully reading this Owner's Manual and/or by accessing the **OptX** Product Support webpage (refer to section B.1.1 [▶169]).

For remote troubleshooting, refer to information in section B.1.2 [▶170].

If you have questions regarding the safety, set-up, operation or maintenance of your Miller product, contact the Miller Service department located in Appleton, WI, USA.

Phone: 1-866-931-9730 or,

Email: PWSService@millerwelds.com

If you cannot resolve the issues by using this Owner's Manual or over the telephone with our technical support group, you might need to return the product to Miller. Refer to section C.1 [▶173] for more details.

B.1.1 Accessing Product Support Webpage

Scanning the QR code specified on the yellow safety label on the front of the unit will take you to the "**OptX** Safety Information" webpage (see Figure 74 [▶169]) at: www.millerwelds.com/optxinfo

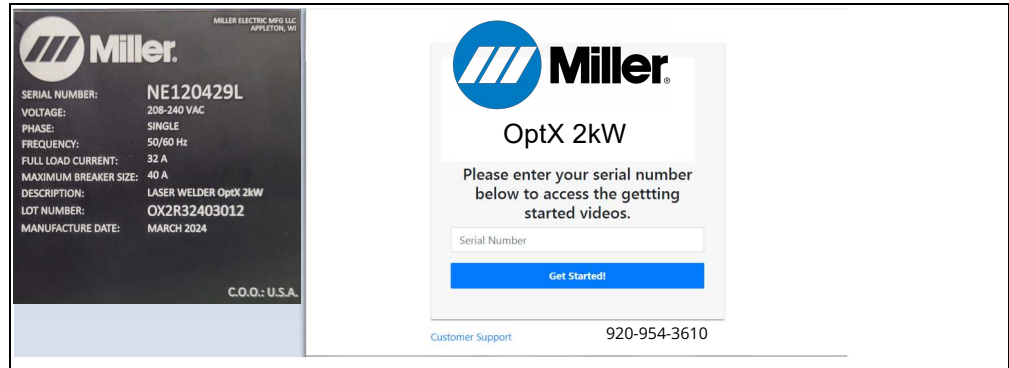
▼ Figure 74. Scan the QR Code on the Yellow Safety Label



The Safety Information Page has important safety information and videos that must be reviewed by all the **OptX** device operators and all personnel that will be working within the welding laser control area.

Input the serial number for your device and click the **Get Started** button. The serial number is specified on the Identification label on the back of the unit.

▼ Figure 75. Input Serial Number to Access Support Page



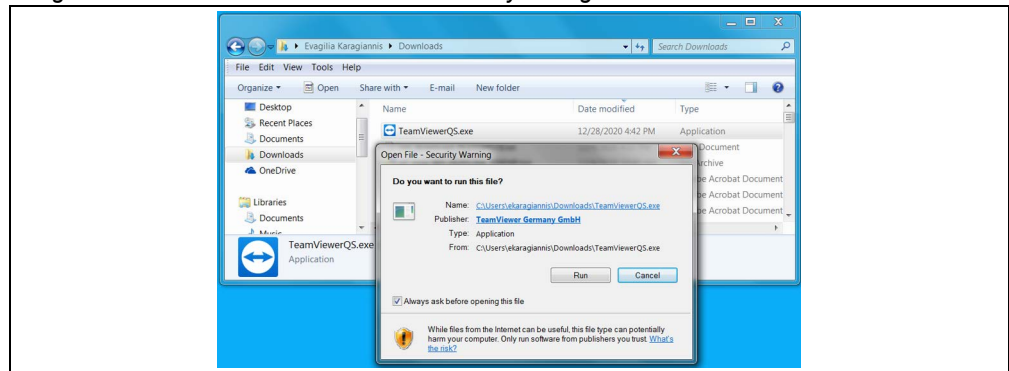
The **OptX** product support page will open. This page provides access to support videos that will assist users in setting up and operating the device. From this page users may also download the Owner's Manual and Process Mode Chart.

B.1.2 Remote Troubleshooting with TeamViewer

Should remote troubleshooting with the Miller Customer Service department be needed:

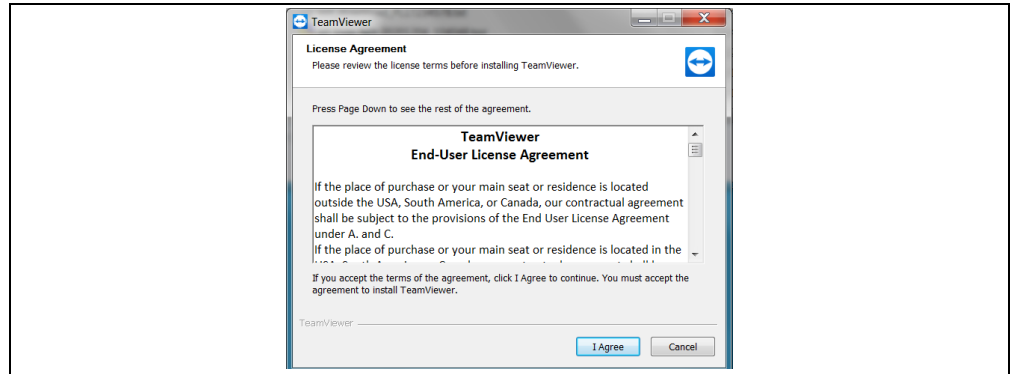
1. Connect a PC via Ethernet to the welder as described in section 9.1 [▶ 127]: Computer Connection to Device.
2. With an active internet connection, open web browser and type in the address: <https://898.tv/lightweld>
3. This will automatically download the TeamViewer executable file.
 - a. Open Windows Explorer and navigate to the **Downloads** folder.
 - b. Double-click on the file **TeamViewerQS.exe** to execute program.
4. You will be prompted by a security warning. Click the **Run** button to continue (see Figure 76 [▶ 170]).

▼ Figure 76. Teamviewer Executable Security Dialog



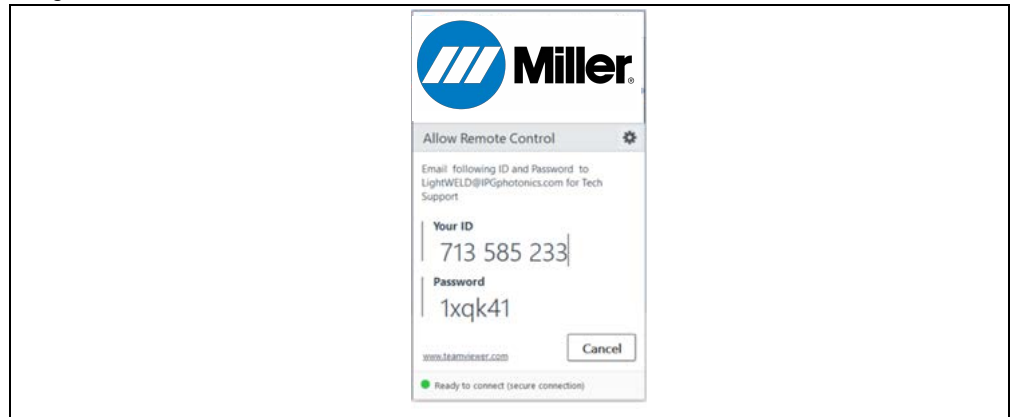
5. The TeamViewer License Agreement dialog will appear. Click **I Agree** button to accept and continue (see Figure 77 [▶ 171]).

▼ Figure 77. TeamViewer License Agreement Dialog



6. A pop-up window will appear. Supply the generated ID and Password to the Miller support team (see Figure 78 [▶ 171]).

▼ Figure 78. Teamviewer Connection ID and Password



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C Product Returns

C.1 Returns to the United States

All product returns require a Return Merchandise Authorization (RMA) from Miller. To obtain an RMA call Miller Customer Service department at 1-866-931-9730 (US) or contact by email at PWSService@millerwelds.com.

If you return a product with a RMA, perform the following procedure:

1. Products must be carefully packed in a suitable shipping container(s). Buyer assumes all responsibility for products damaged in shipment to Miller.
2. Buyer must issue a purchase order for the value of the replaced parts/service items and Miller will issue credit or invoice when the parts/service is received. Speak to Miller Service personnel for the amount authorized under the required purchase order.
3. All requests for repair or replacement under this warranty must be made to Miller within 30 days after discovery of the defect (but not later than 7 days after warranty expiration).
4. All products returned to Miller but which meet applicable specifications, not defectively manufactured or used not in accordance with this Owners Manual, will result in the Buyer being charged Miller's standard examination charge.
5. Complete packing list with product model and serial number will ensure prompt repair.
6. Be sure to include with the returned product your 'ship to' address for the return of the serviced product.

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D Glossary

SI UNIT PREFIX USED (e.g. cm for centimeter)

T = tera (10^{12})	k = kilo (10^3)	d = deci (10^{-1})	μ = micro (10^{-6})	f = femto (10^{-15})
G = giga (10^9)	h = hecto (10^2)	c = centi (10^{-2})	n = nano (10^{-9})	
M = mega (10^6)	da = deca (10^1)	m = milli (10^{-3})	p = pico (10^{-12})	

COMMONLY USED UNITS

s	second (time)	L or l	liters (capacity)
m	meter (length)	lb	pound (mass)
A or Amp	Amperes (electric current)	N	Newton (Force)
°C	Degrees centigrade or Celsius (temperature)	Ω	Ohm (Resistance)
°F	Degrees Fahrenheit (temperature)	Pa	Pascal (pressure)
F	Farad (capacitance)	psi	pound per square inch (pressure)
ft	Foot (length)	rad	radian (plane angle)
Hz	Hertz or cycles per second (frequency)	V	Volt (electric potential)
J	Joule (energy)	W	Watt (power)
g	grams (mass)	yd	Yard
in	inches (length)		

ADDITIONAL SYMBOLS & TERMS

λ	Lambda (wavelength symbol)	LD	Laser diode
AC	Alternating current	LSO	Laser Safety Officer
CDA	Compressed Dry Air	MPE	Maximum Permissible Exposure
CDRH	Center for Devices and Radiological Health (U.S. Government)	NOHD	Nominal Ocular Hazard Distance
CFR	Code of Federal Regulation (U.S. Government)	NHZ	Nominal Hazard Zone
CPU	Central processing unit	OD	Optical Density
CW	Continuous wave (operating mode)	OS	Operating System
DC	Direct current	PE	Protective Earth conductor

EU	European Union is a political and economic union of 27 member states that are located primarily in Europe.	PPE	Personal Protective Equipment
EN	European Norm	QBH	Quartz Block Head
FEL	Foreseeable Exposure Limit	QCW	Quasi-Continuous wave (operating mode)
HPP	High Peak Power (laser operating mode)	rms	Root mean square or quadratic mean
IEC	International Electrotechnical Commission	TCP	Transmission control protocol
IP	Internet protocol	UV	Ultraviolet Radiation. Wavelengths range from 315-400 nm (UV-A), 280-315 nm (UV-B) and 100-280 nm (UV-C).
IR	Infrared Radiation. Wavelengths range from 0.7-1000 microns.	VAC	Voltage alternating current
LAN	Local Area Network	VDC	Volts Direct Current
LCA	Laser Controlled Area	VIS	Visible radiation. Wavelengths range from 400-700 nm.

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Effective January 1, 2024 (Equipment with a serial number preface of NE or newer)

This limited warranty supersedes all previous Miller warranties and is exclusive with no other guarantees or warranties expressed or implied.

LIMITED WARRANTY - Subject to the terms and conditions below, Miller Electric Mfg. LLC, Appleton, Wisconsin, warrants to authorized distributors that new Miller equipment sold after the effective date of this limited warranty is free of defects in material and workmanship at the time it is shipped by Miller. **THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS.**

Within the warranty periods listed below, Miller will repair or replace any warranted parts or components that fail due to such defects in material or workmanship. Notifications submitted as online warranty claims must provide detailed descriptions of the fault and troubleshooting steps taken to diagnose failed parts. Warranty claims that lack the required information as defined in the Miller Service Operation Guide (SOG) may be denied by Miller.

Miller shall honor warranty claims on warranted equipment listed below in the event of a defect within the warranty coverage time periods listed below. Warranty time periods start on the delivery date of the equipment to the end-user purchaser.

1. 5 Years Parts — 3 Years Labor
 - Original Main Power Rectifiers Only to Include SCRs, Diodes, and Discrete Rectifier Modules in non-inverter products
2. 4 Years Parts (No Labor)
 - Auto-Darkening ClearLight 2.0 Helmet Lenses
3. 3 Years — Parts and Labor Unless Specified
 - Auto-Darkening Helmet Lenses (No Labor)
 - Copilot Collaborative Welding Systems
 - Engine Driven Welder/Generators (Including EnPak) **(NOTE: Engines are Warranted Separately by the Engine Manufacturer.)**
 - Insight Welding Intelligence Products (Except External Sensors)
 - Inverter Power Sources
 - Plasma Arc Cutting Power Sources
 - Process Controllers
 - Semi-Automatic and Automatic Wire Feeders
 - Transformer/Rectifier Power Sources
4. 2 Years — Parts and Labor
 - Auto-Darkening Weld Masks (No Labor)
 - Fume Extractors - Filtair 215, Capture 5, and Industrial Collector Series
5. 1 Year — Parts and Labor Unless Specified
 - ArcReach Heater
 - AugmentedArc, LiveArc, and MobileArc Welding Systems
 - Automatic Motion Devices
 - Bernard BTB Air-Cooled MIG Guns (No Labor)
 - CoolBelt, PAPR Blower, and PAPR Face Shield (No Labor)
 - Desiccant Air Dryer System
 - Field Options **(NOTE: Field options are covered for the remaining warranty period of the product they are installed in, or for a minimum of one year — whichever is greater.)**

- RFCS Foot Controls (Except RFCS-RJ45)
 - Fume Extractors - Filtair 130, MWX and SWX Series, Standard, Telescopic, and ZoneFlow Extraction Arms and Motor Control Box
 - HF Units
 - XT Plasma Cutting Torches (No Labor)
 - Induction Heating Power Sources, Coolers **(NOTE: Digital Recorders are Warranted Separately by the Manufacturer.)**
 - Insight Sensors
 - Load Banks
 - MDX Series MIG Guns (No Labor)
 - Motor-Driven Guns
 - Positioners and Controllers
 - Racks (For Housing Multiple Power Sources)
 - Running Gear/Trailers
 - Spoolmate Spoolguns (No Labor)
 - Subarc Wire Drive Assemblies
 - Supplied Air Respirator (SAR) Boxes and Panels
 - TIG Torches (No Labor)
 - Tregaskiss Guns (No Labor)
 - Water Cooling Systems
 - Wireless Remote Foot/Hand Controls and Receivers
 - Work Stations/Weld Tables (No Labor)
6. 6 Months — Parts
 - 12 Volt Automotive-Style Batteries
 7. 90 Days — Parts
 - Accessories (Kits)
 - ArcReach Heater Quick Wrap and Air Cooled Cables
 - Canvas Covers
 - Induction Heating Coils and Blankets, Cables, and Non-Electronic Controls
 - M-Guns
 - MIG Guns, Subarc (SAW) Torches, and External Cladding Heads
 - Remote Controls and RFCS-RJ45
 - Replacement Parts (No labor)

Miller's True Blue Limited Warranty shall not apply to:

1. **Consumable components; such as contact tips, cutting nozzles, contactors, brushes, relays, work station table tops and welding curtains, or parts that fail due to normal wear. (Exception: brushes and relays are covered on all engine-driven products.)**
2. Items furnished by Miller, but manufactured by others, such as engines or trade accessories. These items are covered by the manufacturer's warranty, if any.
3. Equipment that has been modified by any party other than Miller, or equipment that has been improperly installed, improperly operated or misused based upon industry standards, or equipment which has not had reasonable and necessary maintenance, or equipment which has been used for operation outside of the specifications for the equipment.
4. Defects caused by accident, unauthorized repair, or improper testing.

MILLER PRODUCTS ARE INTENDED FOR COMMERCIAL AND INDUSTRIAL USERS TRAINED AND EXPERIENCED IN THE USE AND MAINTENANCE OF WELDING EQUIPMENT.

The exclusive remedies for warranty claims are, at Miller's option, either: (1) repair; or (2) replacement; or, if approved in writing by Miller, (3) the pre-approved cost of repair or replacement at an authorized Miller service station; or (4) payment of or credit for the purchase price (less reasonable depreciation based upon use). Products may not be returned without Miller's written approval. Re-turn shipment shall be at customer's risk and expense.

The above remedies are F.O.B. Appleton, WI, or Miller's authorized service facility. Transportation and freight are the customer's responsibility. TO THE EXTENT PERMITTED BY LAW, THE REMEDIES HEREIN ARE THE SOLE AND EXCLUSIVE REMEDIES REGARDLESS OF THE LEGAL THEORY. IN NO EVENT SHALL MILLER BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOSS OF PROFIT) REGARDLESS OF THE LEGAL THEORY. ANY WARRANTY NOT PROVIDED HEREIN AND ANY IMPLIED WARRANTY, GUARANTY, OR REPRESENTATION, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE, ARE EXCLUDED AND DISCLAIMED BY MILLER.

Some US states do not allow limiting the duration of an implied warranty or the exclusion of certain damages, so the above limitations may not apply to you. This warranty provides specific legal rights, and other rights may be available depending on your state. In Canada, some provinces provide additional warranties or remedies, and to the extent the law prohibits their waiver, the limitations set out above may not apply. This Limited Warranty provides specific legal rights, and other rights may be available, but may vary by province.

Warranty Questions?

Call 1-800-4-A-MILLER for your local Miller distributor.

Your distributor also gives you...

Service

You always get the fast, reliable response you need. Most replacement parts can be in your hands in 24 hours.

Support

Need fast answers to the tough welding questions? The expertise of the distributor and Miller is there to help you every step of the way.

Owner's Record

Please complete and retain with your personal records.

Model Name	Serial/Style Number
Purchase Date	(Date which equipment was delivered to original customer.)
Distributor	
Address	
City	
State	Zip

For Service

Contact a *DISTRIBUTOR* or *SERVICE AGENCY* near you.

Always provide Model Name and Serial/Style Number.

Contact your Distributor for:	Welding Supplies and Consumables
	Options and Accessories
	Personal Protective Equipment (PPE)
	Service and Repair Replacement Parts
	Training (Schools, Videos, Books)
	Welding Process Handbooks
	To locate a Distributor or Service Agency visit www.millerwelds.com or call 1-800-4-A-Miller

Contact the Delivering Carrier to:	File a claim for loss or damage during shipment.
	For assistance in filing or settling claims, contact your distributor and/or equipment manufacturer's Transportation Department.

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