Scanner Series User Guide

High-Power & Mid-Power

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1.0 Overview

1.1 Introduction

The IPG remote processing heads are powerful and flexible tools for applications which require high speed scanning and accurate laser beam positioning.

Different from most scanner products currently offered in the market, IPG scanners combine a powerful software suite, state-of-the-art electronics and mechanical hardware, with cutting-edge optical systems to provide a complete package specifically tailored to meet the needs of any remote welding, cleaning, and marking application.

IPG's unique scanner control system sets IPG scanners apart from most other scanners on the market today. The purpose of the IPG Scan Controller scheme is to synchronize laser emission and the motion of the scanner galvos. This helps ensure the laser light is delivered to the right place, at the right time.

While this may sound simple, in actuality it is a very difficult task. In most systems, the position of the mirror is assumed to be accurately reported by the scanner's position sensor. Unfortunately, this is almost never the case; as the motor and mirrors rotate at high accelerations, there is some difference between the mirror's position and the position sensor output. The only time the position sensor provides a reliable position is when the mirror is at rest.

Traditional control schemes overcome the inaccuracy by relying on time delays after significant motions (jumps and line scans). These delays allow the mirrors to settle and achieve *apparent* synchronization. However, these delays also result in significant reduction of the system's throughput. Time delays throughout the whole job are determined by the worst-case part of the job, even when shorter delays would suffice. This is incredibly detrimental to system performance.

IPG scanning systems provide an optimized performance, with adaptive scan control based on predictive servo control. Using a mathematical model of the moving elements, the IPG Scan Controller accurately predicts the mirrors' actual position. This predictive information is sent back to the IPG software where the scanner and laser commands dynamically adapt to the immediate situation and job requirements.

Another advantage of the IPG software, IPGScan, is that it relies on the real physics of the scanners, meaning its control scheme is acceleration based. This states, in theory, any scan velocity can be achieved, as long as there is enough time and scan angle to reach such velocity within the maximum acceleration restrictions.

1.2 Applications

The IPG remote processing heads are optimized for mid to high-power scanning applications such as remote welding, cutting (thin foils), deep engraving, and surface treatment.

1.3 Features

- Laser power handling
- Completely sealed for long-term stability
- Plug-and-play architecture for IPG Photonics YLR, YLS, and YLP series lasers
- Pre-calibrated scan field
- Available with IPGScan Software

1.4 Additional Documentation

For details on IPG Photonics QCW and CW Lasers, refer to the following documentation (depending on the IPG Photonics laser you are using:

- YLR-Series Laser User Guide
- YLS-Series Laser User Guide
- YLP-Series Laser User Guide

For additional details and information on the use of IPGScan software, please refer to the following documentation:

- IPGScan User Guide

Additional detail on IPG Scanners, accessories, and part numbers can be found in the following documentation:

- IPG Photonics High-Power Scanners Brochure

1.5 Certification

IPG certifies that the High-Power and Mid-Power Scanners are thoroughly tested, inspected, and meet published specifications prior to shipping.

Upon receiving your shipment, check the packaging for any possible damage that could have occurred in transit. If damage is apparent, contact IPG immediately.

This product does not comply with IEC 60825, 21 CFR 1040.10 and/or 1040.11. This product is for use as a system component only and it is the responsibility of the purchaser/end-user to bring the end system into full compliance with all applicable regulations and evaluate and mitigate risks associated with the end use.

IPG Scanners are for use only with IPG Photonics laser systems and accessories.

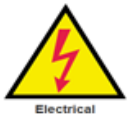
1.6 Safety Information and Conventions

To ensure the safe operation and optimal performance of the product, follow all warnings in this guide. 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. Never open the chassis. There are no user-serviceable parts, equipment or assemblies associated with this product. All internal service and maintenance should only be performed by qualified IPG personnel.

Table 1.1 lists safety conventions and their meanings. These conventions are used throughout this guide.

Table 1.1 Safety Conventions and Meanings

Symbol	Description
 	Text marked with an **Electrical Warning** symbol or **Laser Warning** symbol refers to a potential personal hazard. It requires a procedure that, if not correctly followed, can result in bodily harm to you or others. Do not proceed beyond the Electrical Warning or Laser Warning symbols until you completely understand and meet the required conditions.
	Text marked with a **CAUTION** symbol refers to a potential product hazard. It requires a procedure that, if not correctly followed, can result in damage or destruction to the product or components. Do not proceed beyond the Caution symbol until you completely understand and meet the required conditions.
No Symbol	Text marked with **Important** refers to pertinent information regarding the operation of the product. Ensure you do not overlook this information.

1.6.1 EMC Compliance

The YLS-Series lasers are components and should be integrated into a finished system. The EMC (CE mark relevant) standards are not applicable to the laser modules, however are applicable to the complete systems. The system integrator is responsible to comply with all applicable standards to the final laser system.

Results of IPG testing program have demonstrated the possibility to build a CE compliant laser system with an integrated YLS-series laser module.

The 2D Scanner and 2D Scan Controller complies with applicable EMC requirements.

1.6.2 Laser Classification

Governmental standards and requirements specify that laser products must be classified according to their accessible emissions accounting for power, energy, temporal, and wavelength characteristics. The 2D Scanner Series are marked with the classifications that apply only to it as a standalone component. The 2D Scanner Series are intended to be used with a Class 4 laser source; therefore, all precautions associated with Class 4 laser products should be taken.

Always consult the labeling and documentation for the laser products that are to be used with IPG Scanners. Classification is based on U.S. regulation Title 21 CFR, Chapter 1, sub-chapter J, part 1040.10© and according to the European Community standard EN 60825-1.

When connected to a Class 4 laser source, this product is capable of channeling visible and invisible laser radiation at high energy and power levels from the laser source to other working media. Direct or indirect exposure of this level of light intensity may cause damage to the eye or skin. Even if the laser radiation is invisible, the beam may cause irreversible damage to the retina and/or cornea and skin.

WARNING: Use appropriate laser safety eyewear when operating this device. The selection of appropriate laser safety eyewear requires the end-user to accurately identify the range of wavelengths emitted from this product. If the device is a tunable laser or Raman product, it emits light over a range of wavelengths and the end user should confirm the laser safety eyewear used protects against light emitted by the device over its entire range of wavelengths.

WARNING: Use of controls or adjustments or performance of procedures other than those set forth in this guide can result in hazardous radiation exposure.

WARNING: The red guide laser can be installed in the connected laser product. It can emit up to 1mW average power near 660 nm wavelength and is classified as Class 2M visible laser radiation in terms of IEC 60825-1. Avoid direct eye exposure.

CAUTION: Do not attempt to install or terminate fibers to the 2D scanner when laser is active.

1.6.3 Safety Labels

Table 1.2 lists the safety labels included on the IPG Scanners and Scan Controllers.

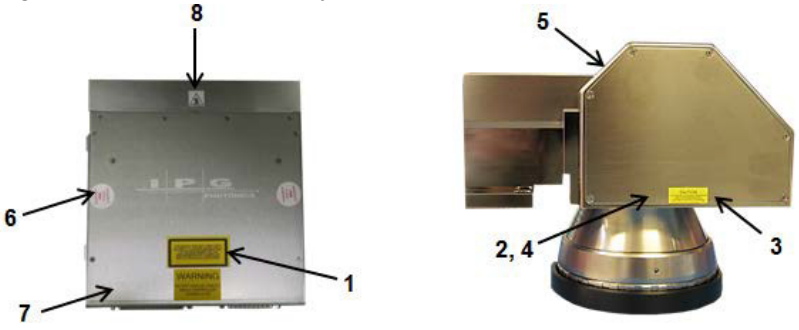
Table 1.2 Safety Labels

Label Name	Description	Label Name	Description
Component Label	THIS PRODUCT DOES NOT COMPLY WITH IEC 60825-1, 21 CFR 1040.10 and/or 1040.11 FOR USE AS A SYSTEM COMPONENT ONLY. IT IS THE RESPONSIBILITY OF THE PURCHASER/END-USER TO BRING THE END SYSTEM INTO FULL COMPLIANCE WITH ALL APPLICABLE REGULATIONS	Identification Label	PN: P30-010057-A3C1 SN: 23170 Rev. C Manufactured: XX-XXXX IPG Photonics Corp. 50 Old Webster Road Oxford, MA, U.S.A
Laser Radiation Hazard Label		Warranty Void Sticker	WARRANTY VOID IF SEAL IS BROKEN
Class 4 Laser Product	DANGER - CLASS 4 VISIBLE AND/OR INVISIBLE LASER RADIATION WHEN OPEN AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION IEC 60825-1:2014	Functional Earth Label	
Aperture Label	AVOID EXPOSURE VISIBLE AND/OR INVISIBLE LASER RADIATION IS EMITTED FROM THIS APERTURE	Hot Surface Label	

1.6.4 Safety Labels Description and Location

The location of the safety labels on the Mid-Power lasers, are shown in Figure 1.1.

Figure 1.1 Mid-Power Safety Label Location



The label locations are as follows:

1. **Component Label**: Top of Scan Controller.
2. **Laser Radiated Hazard Label**: Both sides of Scan head.
3. **Class 4 Laser Product Label**: various locations on Scan head.
4. **Aperture Label**: Both sides of Scan head.
5. **Identification Label**: Back of Scan head and sides of Scan Controller.
6. **Warranty Void Sticker**: Top of Scan Controller (various locations)
7. **Functional Earth Label**: Side of Scan Controller

8. **Hot Surface Label**: Top of Scan Controller.

The location of the safety labels on the High-Power lasers, are shown in Figure 1.2.

Figure 1.2 High-Power Safety Label Locations

The label locations are as follows:

9. **Component Label**: Top of Scan Controller.
10. **Laser Radiated Hazard Label**: On Aperture Label (various locations).
11. **Class 4 Laser Product Label**: various locations on Scan head.
12. **Aperture Label**: various locations on Scan head.
13. **Identification Label**: Left sidesof Scan Controller.
14. **Warranty Void Sticker**: Top of Scan Controller (various locations)
15. **Functional Earth Label**: Side of Scan Controller
16. **Hot Surface Label**: Top of Scan Controller.

1.7 General Safety Warnings

WARNING: You must exercise caution to avoid and minimize specular reflections as these reflections occur at the laser's wavelength and are invisible.

1.7.1 Specular Reflections

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

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 to materials surrounding the laser.

WARNING: The laser light is strong enough to cut or weld metal, burn skin, clothing, and paint. In addition, this light can ignite volatile substances such as alcohol, gasoline, ether, and other solvents. Exposure to solvents or other flammable materials and gases must be avoided and must be relocated away from this device.

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

Exposure to solvents or other flammable materials and gases must be avoided and must be relocated away from the device.

1.7.2 Optical Safety

CAUTION: Never look directly into a live fiber or collimator and make sure that you wear appropriate laser safety eyewear at all times while operating the product.

- **Never look into the scanner head when it is connected to a laser product**.
- If the output of the device is delivered through a lens with an anti-reflection coating, ensure that the lens is of good quality and clean. Hot or molten pieces of metal might be present where the laser beam is emitted in the end application. Exercise caution if debris is being generated in your application.
- Hot or molten pieces of metal can be present when using this device. Exercise caution if debris is being generated in your application.
- Do not exceed the maximum specified optical input for the 2D Scanner.
- Ensure all electrical and optical connections are connected to the correct locations.
- Proper enclosures must 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. In addition, it is important to install the output assembly away from eye level.
- The interaction between the laser and the material being processed can also generate high intensity UV and visible radiation. Ensure that all laser enclosures are in place to prevent eye and skin exposure to visible and invisible collateral radiation.

1.7.3 Electrical Safety

WARNING: Ensure the device is properly grounded through a low impedance functional earth conductor.

To ensure electrical safety:

1. Always use your device in conjunction with properly grounded power source.
2. Before supplying power to the product, make sure that the correct voltage of the DC power source is used. Failure to use the correct voltage could cause damage to the product.
3. Before switching the power on, ensure the voltage corresponds to the specified level.

4. There are no operator serviceable parts inside. Do not attempt replacement of any parts. Refer all servicing to qualified IPG personnel. Do not remove covers. Any tampering with the product might void the warranty.
5. 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).
6. Keep away from sources of shock or vibrations.

1.7.4 Environmental Safety

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.

CAUTION: Damage to the laser is possible, unless caution is employed in operating the device.

Important

Do not dispose of the product with domestic waste. Electronic devices have to be disposed according to the regional directives on electronic and electric waste disposal.

IPG provides the following recommendations to promote the long life of the 2D Scanner:

- Do not expose the device to a high moisture environment (>95% humidity).
- Ensure that the work area is properly vented. Gases, sparks, and debris that can be generated from interaction between the laser and the work surface can pose additional safety hazards.

1.8 Safety Features

1.8.1 Fiber Interlock

A fiber interlock is satisfied when an IPG fiber is properly secured to the 2D Series Scanner. Two relay outputs are available at the customer interface indicating the status of this interlock. These signals are provide for integrating into the customers safety electronics.

1.9 Additional Safety Resources

For additional information regarding Laser Safety, refer to the following list:

American National Standards Institute

ANSI Z136.1-2014, American National Standard for the Safe Use of Lasers (Available through LIA)

US Department of Labor - OSHA

Publication 8-1.7 - Guidelines for Laser Safety and Hazard Assessment

Laser Institute of America (LIA)

13501 Ingenuity Drive, Suite 128

Orlando, Florida 32826

Phone: 407.380.1553, Fax: 407.380.5588 Toll Free: 1.800.34.LASER

International Electro-technical Commission

IEC 60825-1, Edition 3, 2014

Safety of laser products -

Part 1: Equipment classification, requirements and user's guide. (Available through LIA)

Center for Devices and Radiological Health

21 CFR 1040.10 - Performance Standards for Light-Emitting Products US Department of Labor - OSHA

Publication 8-1.7 - Guidelines for Laser Safety and Hazard Assessment

Laser Safety Equipment

Laurin Publishing

Laser safety equipment and Buyer's Guides

Important IPG Photonics recommends that the user of this product investigate any local, state or country 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 such as ANSI, IEC, and OSHA are current.

1.10 Unpacking Instructions

Note If the packaging shows any signs of external damage, check unit for damages and notify the shipping agent immediately.

CAUTION: To minimize the risk of damage to the device, IPG Photonics recommends that you unpack your 2D Scanner using the following procedure.

1.10.1 Unpacking a Unit from the Shipping Carton

To unpack your unit from the shipping carton:

1. Place the package on a stable surface such as the floor or a large table.
2. Open the carton and remove the foam cover and store for later use.
3. Carefully lift the Scanner out of the box.
4. Carefully place contents on a stable surface.
5. Remove the lens cover from the 2D Scanner before use. Store for later use if needed.

6. Do not remove the cap that covers the fiber port until a fiber is ready to be immediately installed. Remove the cap to install the fiber; it should be re-installed whenever the fiber is removed.
    a. A 44-pin Male Scan Head Control cable is included with your shipment. This cable connects to the Scan Controller box for the Mid-Power and High-Power Scanners.
7. Retain all packaging for future transportation or storage needs.

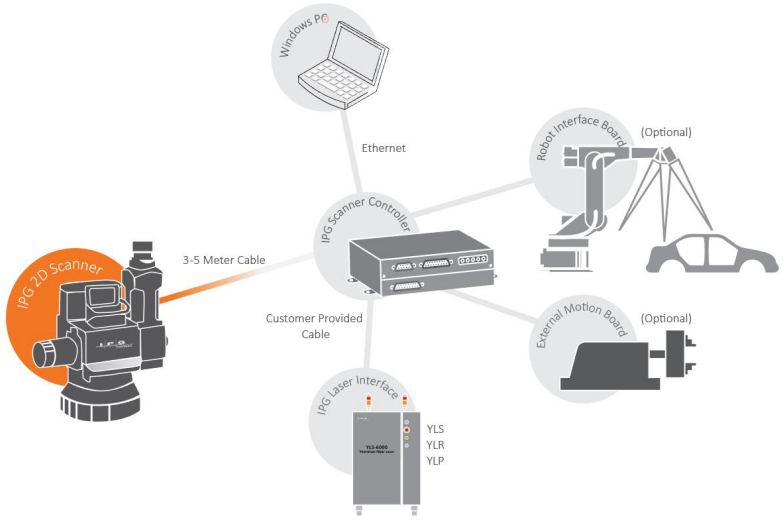
2.0 System Architecture

IPG Remote Scanning heads are designed to be used in a number of different methods and applications. The following sections outline common system architectures that IPG remote processing heads are used in.

2.1 IPG Scan Controller

Figure 2.1details the basic system architecture when using an IPG Scan Controller. The basic system is composed of the following components:

Figure 2.1 IPG Controller Architecture



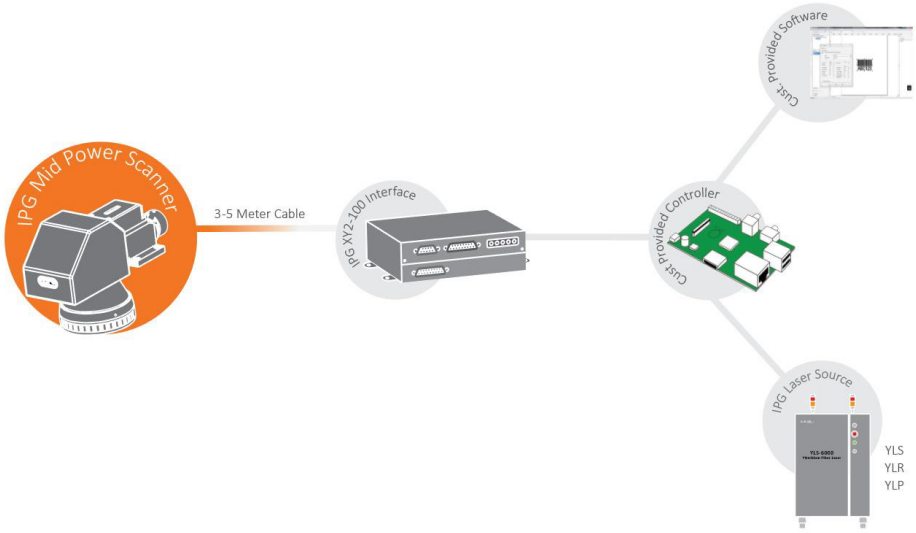
- Scan Head:
  - Houses the galvo mirrors and beam shaping optics (collimator, field flattening lenses, etc.)
- Scan Controller:
  - Houses all electronics, including controller board, galvo driver boards, etc.
  - Available for Mid-Power and High-Power Scanners
- Windows PC & Windows PC software:
  - Builds galvo trajectories and laser control based on laser type and scanner configuration
  - Software provided with purchase of scanner.
  - Computer purchased separately.
- Laser source:
  - IPG laser sources: YLS, YLR, YLP
  - Sold as a separate line item from scanner

Important **CUSTOMER MUST BUILD CONNECTION CABLE BETWEEN SCAN CONTROLLER AND LASER.**

2.2 XY2-100 Interface (Mid-Power head only)

Figure 2.2 details the basic system architecture when using an XY2-100 interface. The basic system is composed of the following components:

Figure 2.2 XY2-100 Interface Architecture

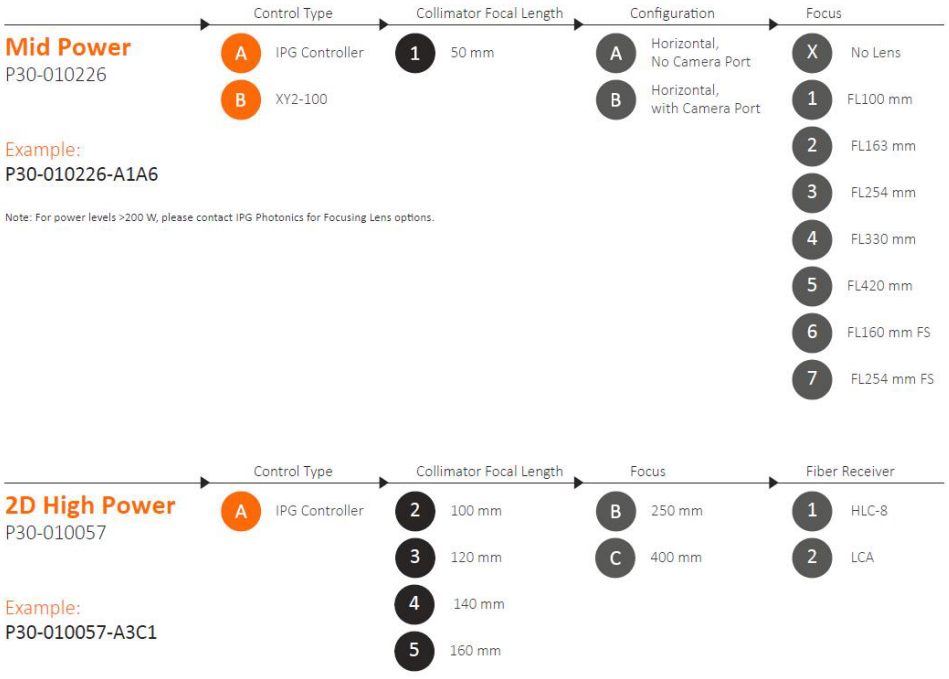


- Scan Head:
  - Houses the galvo mirrors and beam shaping optics (collimator, field flattening lenses, etc.)
- Scanner XY2-100 interface:
  - Houses all electronics, including controller board, galvo driver boards, etc.
  - For use with Mid-Power Scanners Only.
- Customer Provided controller:
  - Controls both scanner and laser. Usually communicates with a software interface where user creates the laser jobs.
- Laser source:
  - IPG laser sources: YLS, YLR, YLP
  - Sold as a separate line item from scanner

2.3 Product Part Numbers

Figure 2.3 details part number specifications:

Figure 2.3 Part Number Diagram



3.0 Product Specifications

The following sections outline the specifications for each scanner.

3.1 Mid-Power Scanner

Table 3.1 Mid-Power Specifications

Specification						**Units**
Wavelength	1030 – 1080					nm
Maximum Laser Power (low power lens)	200					W
Maximum Laser Power (fused silica lens)	2					kW
Clear Aperture	12					mm
Fiber Adapter	HLC-8					
Dynamic Performance						**Units**
Tracking Delay	100					µs
Repeatability (rms)	< 5					µrad
Control type	IPG Controller, XY2-100					
Optical Specifications						**Units**
Collimator Length	50					mm
F-Theta Options (low power*)	100	163	254	330	420	mm
Field Size	60x60	110x110	170x170	204x204	300x300	mm^2
**Working Distance	102	186	285	390	493	mm
F-Theta Options (Fused Silica)	163		254			mm
Field size	80x80		160x160			mm^2
**Working Distance	135		245			mm
Other						
Weight	9 lbs. (with FL254)					

* Only for power < 2kW

** This is nominal and values will vary slightly from lens to lens. Working distance is measured from the bottom (lowest metal portion) of the lens assembly.

3.2 2D High-Power Scanner

Table 3.2 High-Power Specifications

Specification					**Units**
Wavelength	1030 – 1080				nm
Maximum Laser Power	12				kW
Clear Aperture	33				mm
Fiber Adapter	HLC-8, LCA				
Dynamic Performance					**Units**
Tracking Delay	500				µs
Repeatability (rms)	< 5				µrad
Control type	IPG Controller				
Optical Specifications					**Units**
Collimator Length	100	120	140	160	mm
F-Theta Options (low power*)	254		415		mm
Field Size	110x110		200x200		mm^2
**Working Distance	261		415		mm

Angles of Incidence and Convergence (At work Surface)			
Lens	Beam X Angle at Corners	Beam Y Angle at Corners	Beam Z Angle at Corners
254mm	±13.0º	±11.8º	±2.75º
400mm	±8.25º	±9.79º	±4.0º

Other	
Weight	25-30 lbs. (Depending on Configuration)

** This is nominal and values will vary slightly from lens to lens. Working distance is measured from the bottom (lowest metal portion) of the lens assembly.

3.3 3D High-Power Scanner

Table 3.3 3D High-Power Specifications

Specification		**Units**
Wavelength	1030 – 1080	nm
Maximum Laser Power	12	kW
Fiber Adapter	HLC-8, LCA	
Dynamic Performance		**Units**
Tracking Delay	500	µs
Repeatability (rms)	< 5	µrad
Control type	IPG Controller	
Optical Specifications		**Units**
Magnification	3.2x	
Field Size	300x300x100	mm^2
Working Distance	470±50	mm
Other		
Weight	35-40 lbs. (Depending on Configuration)	

3.4 Temperature, Humidity, and Water Cooling Specifications

Table 3.4 details temperature, humidity and water cooling specifications for Mid-Power and High-Power laser systems.

Table 3.4 Temperature, Humidity, and Water Cooling Specifications

Temperature & Humidity		**Units**
Opearting Temperature Range	10-40 (50-104)	ºC (ºF)
Humidity	10-90%RH non-condensing	
Water Cooling - High-Powered Scanners		**Units**
DI or Tap Water Temperature	25-30	ºC
	77-86	ºF
Flow Rate Minimum	0.75	l/min
Water Cooling - Mid-Powered Scanners (if laser power > 1kW)		**Units**
DI or Tap Water Temperature	25-30	ºC
	77-86	ºF
Flow Rate Minimum	0.75	l/min

3.5 Crossjet/Air Knife Specifications

Table 3.5 outlines air quality requirements for Crossjet/Air Knife use.

Table 3.5 Crossjet/Air Knife Specifications

Quality Class	Particle Size (µm)	*Dew Point		Oil Content (mg/m^3)
		°C	°F	
1	0.1	-70	-94	0.01
2	1	-40	-40	0.1
3	5	-20	-4	1
4	15	3	37	5
5	40	7	45	25

* Dew point must be safely below minimum operating temperature.

Crossjet/Air knife supply requirements: Quality classes 1-5 are all acceptable.

For maximum air flow through the air knife, you need to have at least ½-inch ID hose as the final connection for a 9-inch knife fed by a ¾-inch ID to the compressor. A 9-inch knife needs approximately 30CFM at 100psi.

3.6 Computer Specifications

In order to operate any IPG Scanners, a computer must be connected and running IPGScan at all times.

The following details minimum computer specifications that should be met for use with IPGS-can software.

- Windows 7 & 10, Professional or higher
  - Home version is not supported
- i5 processor or higher
- 4GB or more of RAM
- Up to 4 Ethernet Ports
  - One is required for connecting to the Scan Controller
  - Optional Ethernet port for connection with PLC.
  - Optional Ethernet port for connecting to Laser/LaserNet
  - Optional Camera Connection

4.0 Mechanical Connections and Drawings

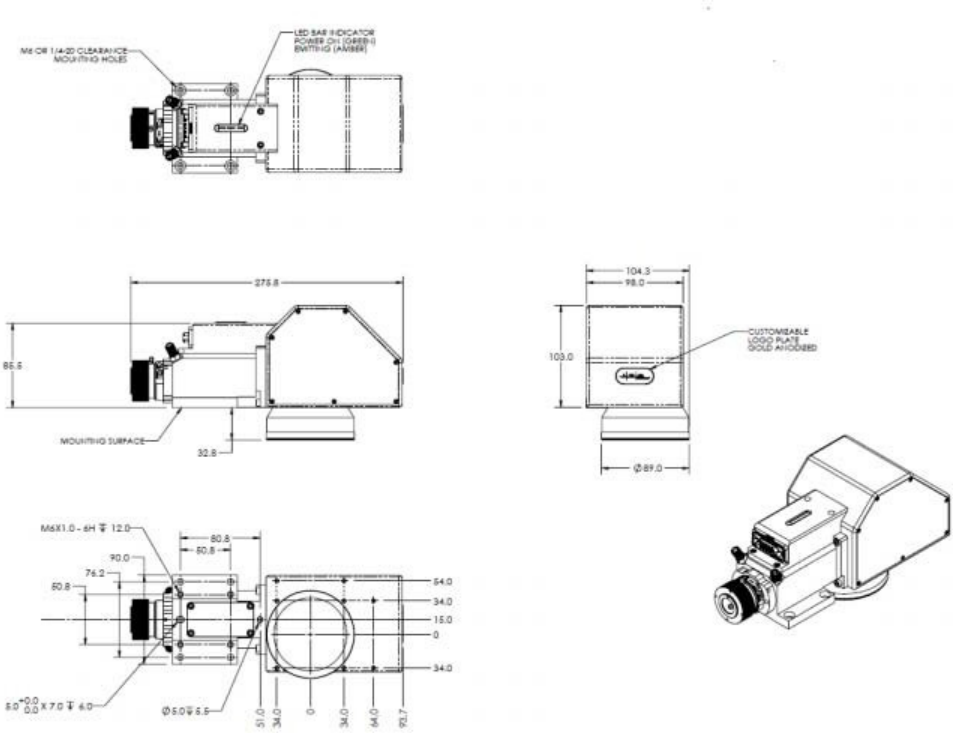
The following sections outline the mechanical dimensions and connections for each specific product.

4.1 Mid-Power Scanner

4.1.1 Diagram

Please see Figure 4.1 for Mid-Power Scanner dimensions.

Figure 4.1 Mid-Power Scanner Diagram



4.2 2D High-Power Scanner

4.2.1 Diagram

Please see Figure 4.2 and Figure 4.3 for High-Power Scanner dimensions.

Figure 4.2 High-Power Scanner Diagram

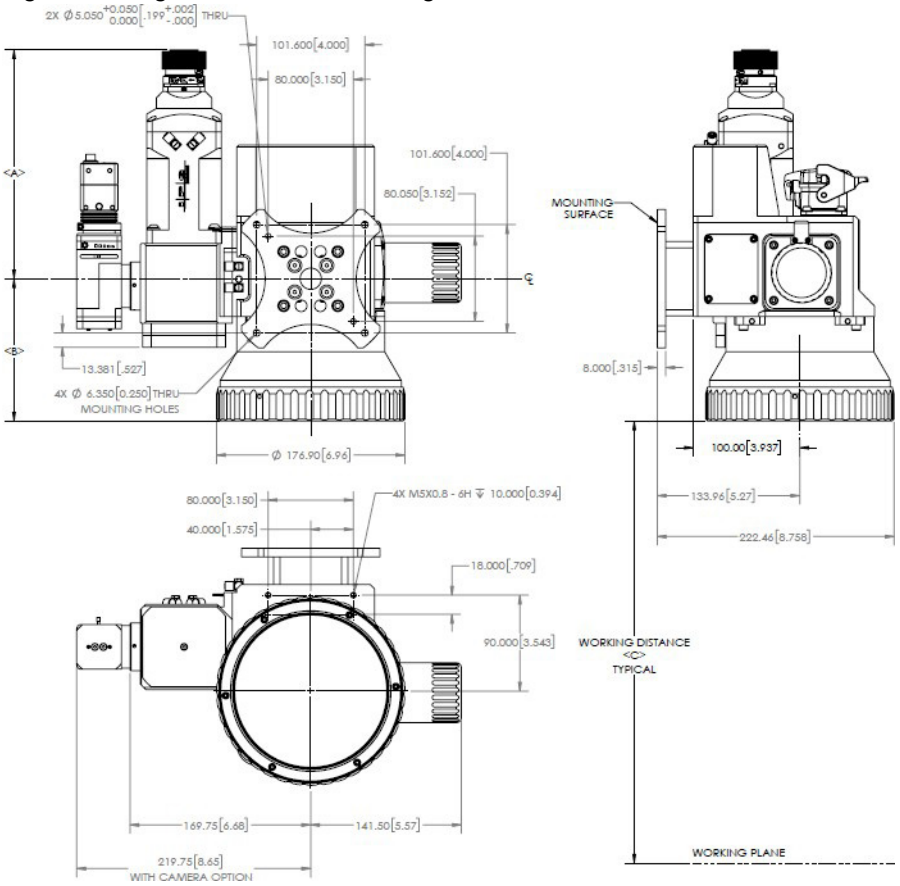


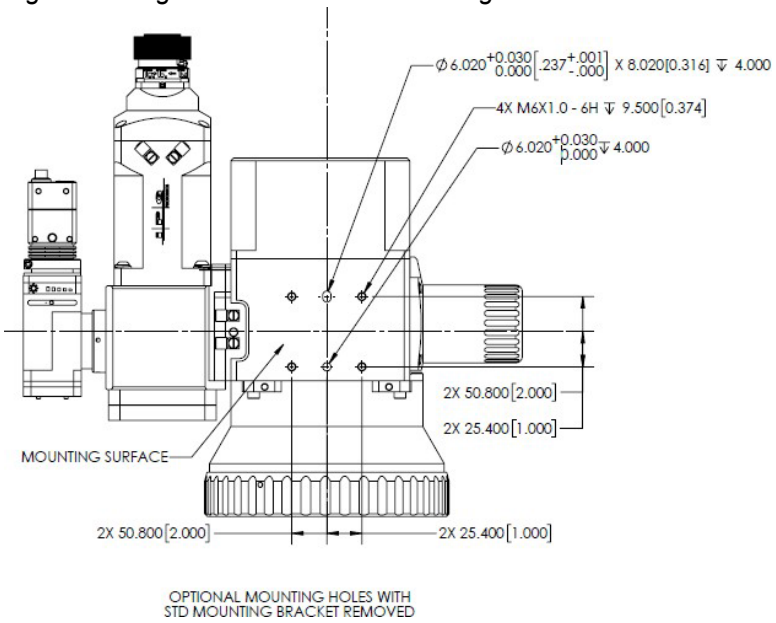
Figure 4.3 High-Power Scanner Diagram Dimensions

TABLE A			
DIMENSION mm [IN]	A	B	C ±5 [0.2]
DEVICE	QBH/LCA	QBH/LCA	QBH/LCA
Collimator (100)	193.4 [7.61]/194.7 [7.67]	---	---
Collimator (120)	214.9 [8.46]/216.2 [8.51]	---	---
Collimator (140)	235.6 [9.28]/236.8 [9.32]	---	---
Collimator (160)	257.4 [10.13]/258.6 [10.18]	---	---
f-Theta Lense (254)	---	140.04 [5.51]	261 [10.28]
f-Theta Lense (413)	---	133.6 [5.26]	415 [16.34]

4.2.2 Mounting Holes

Figure 4.4 details the mounting holes located on the backside of the 2D High-Power Scanner. Figure 4.2 details the 2D High-Power Scanner with the optional mounting bracket (included with purchase of scan head).

Figure 4.4 High-Power Scanner Mounting Holes



4.2.3 Mass Properties

The following mass properties were taken from the center point of the mounting holes. The positive Z axis goes from the mounting holes towards the IPG logo. The positive X axis goes from the mounting holes up towards the laser fiber inlet.

Table 4.1 High-Power Scanner Mass Properties with Camera

2D High-Power Scanner Mass Properties with Camera			
Item	**Specifications**		
Mass	12kg		
Center of Mass (mm)	X = 2.54 Y = -34.62 Z = 77.69		
Moments of Inertia ($kg*mm^2$)	Ixx = 166309.44	Ixy = -26569.77	Ixz = -10180.53
	Iyx = -26569.77	Iyy = 164895.30	Iyz = -20281.99
	Izx = -10180.53	Izy = -20281.99	Izz = 154669.50

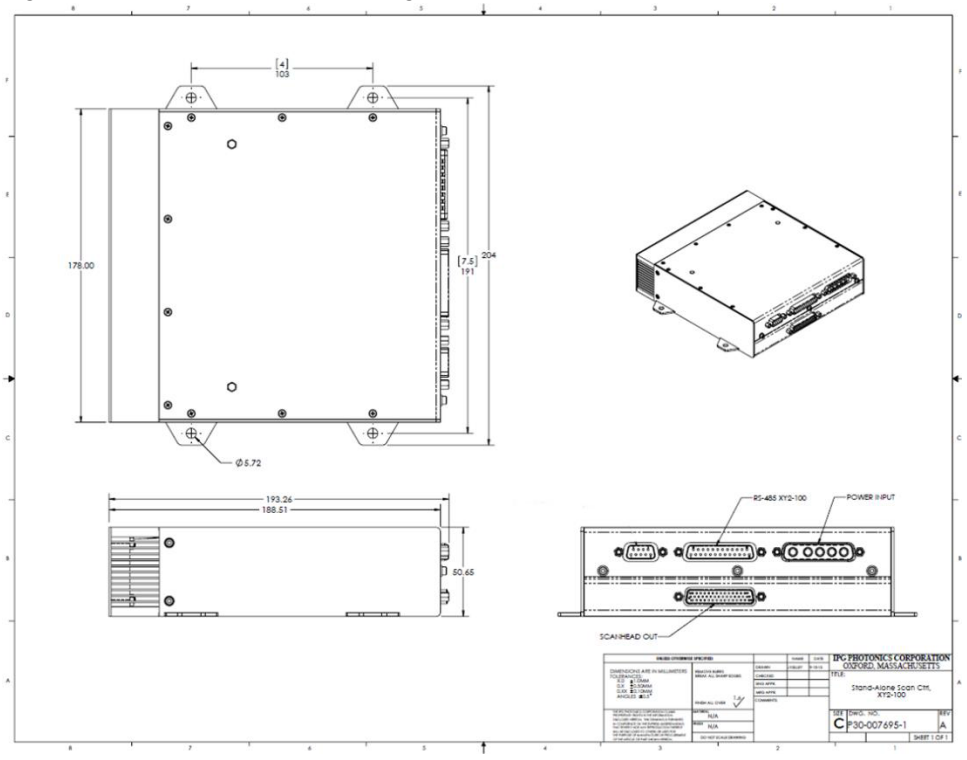
Table 4.2 High-Power Scanner Mass Properties without Camera

2D High-Power Scanner Mass Properties without Camera			
Item	**Specifications**		
Mass	11.5kg		
Center of Mass (mm)	X = 1.37 Y = -27.32 Z = 78.55		
Moments of Inertia ($kg*mm^2$)	Ixx = 145963.88	Ixy = -23828.98	Ixz = -10983.61
	Iyx = -23828.98	Iyy = 161693.82	Iyz = -14755.43
	Izx = -10983.61	Izy = -14755.43	Izz = 134561.74

4.3 Scan Controllers

Figure 4.5 provides the dimensions of a Scan Controller. Although the XY2-100 interface is shown, all the IPG 2D Scan Controllers consists of the same dimensions (only electrical connections change).

Figure 4.5 Scan Controller Drawing



4.4 Fiber Connection

4.4.1 Overview

The scan heads use IPG Process Collimators which are factory aligned and water-cooled for optical & thermal stability. Collimators are equipped with FCH-8/HLC-8 (sometimes referred to as QBH) or LCA/QD type fiber receivers which are **only** compatible with the corresponding fiber bayonets.

Identify the type of fiber receiver and fiber bayonet and follow the appropriate instructions to connect the laser fiber to the remote processing head.

3D High-Power heads have a dirt tray in order to prevent dirt from falling inside the head during fiber connection. The tray is located below the fiber connector and must be locked during operation; otherwise a Fiber Interlock error may be displayed.

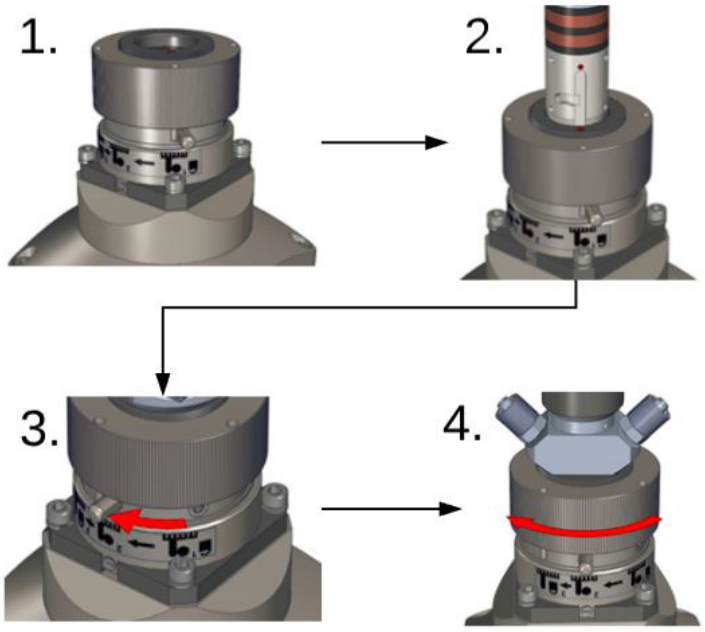
To minimize contamination of optics, install or remove the fiber with the head in a horizontal position.

4.4.2 HLC-8/QBH Fiber Receiver

The following steps outline the procedure to connect a FCH-8/HLC-8 fiber and receiver. See Figure 4.6.

1. Rotate the knurled knob on the fiber receiver so the pins are aligned with the graphic on the receiver.
2. Align the red dot on the fiber and receiver and insert the bayonet.
3. Rotate the large pin on the receiver until it stops (the smaller pin will also rotate).
4. Rotate the knurled knob on the receiver until it no longer moves.

Figure 4.6 HLC-8/QBH Fiber Receiver Connection



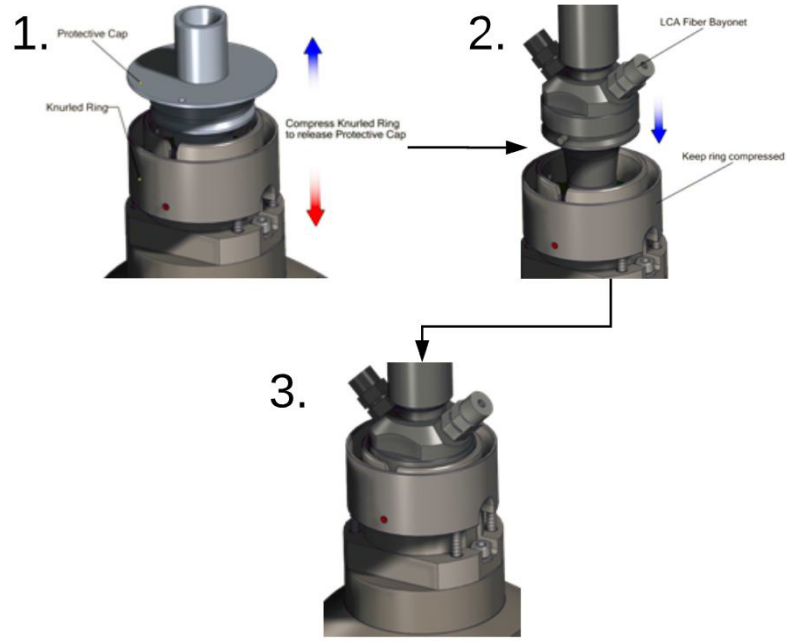
To remove the fiber, reverse the order of steps 1-4.

4.4.3 LCA/QD Fiber Receiver

The following steps outline the procedure to connect a LCA/QD fiber and receiver. See Figure 4.6.

1. Compress the knurled ring to release the protective cap.
2. While keeping the ring compressed, insert the LCA fiber bayonet. Be sure the pin on the bayonet aligns with the red dot on the receiver.
3. Release the ring and double check to make sure it is securely locked in place.

Figure 4.7 LCA/QD Fiber Receiver Connection



To remove the fiber, reverse the order of steps 1-3.

5.0 Supplementary Equipment/Accessories

5.1 Air Knife Mounting

Whether marking, cleaning, or welding, an air knife should always be utilized with the scanner in order to help protect the coverslide from debris.

An Air Knife is recommended to protect the cover slide window from contamination. It uses compressed air for dust blow off and cooling through the use of an airflow that covers the entire welding surface.

5.1.1 Mid-Power

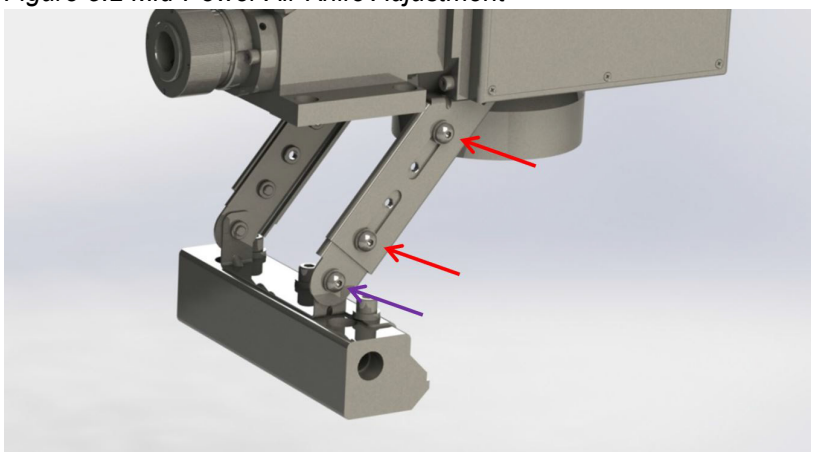
To mount an air knife to the Mid-Power Scanner, please refer to the following procedure.

1. Mount the air knife assembly to the mounting holes located on the bottom of the scan head using two bolts. The air knife assembly can be mounted to face any direction in the field of view.

Figure 5.1 Mid-Power Air Knife Mount

2. Adjust the angle of the air knife by loosening bolts.
3. Adjust the slide assembly by loosening bolts (on each slide).
    a. For optimal protection. The air knife should be positioned well below the coverslide.

Figure 5.2 Mid-Power Air Knife Adjustment

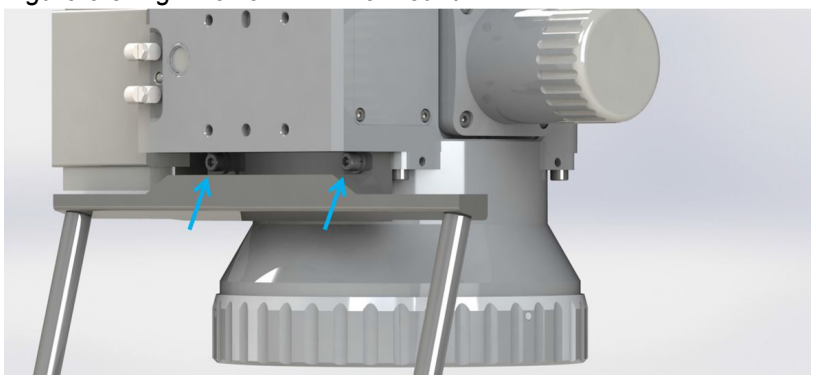


5.1.2 High-Power

To mount an air knife to a 2D HP Scanner:.

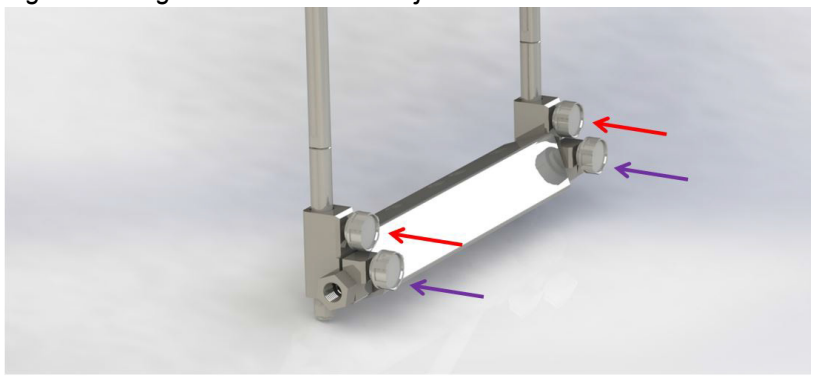
1. Mount one or more air knives to the mounting holes located on the front, left side or back of the 2D Scanner Head (see Figure 5.3).

Figure 5.3 High-Power Air Knife Mount



2. Adjust the angle of the air knife by loosening clamps (see Figure 5.4).
3. Loosen the set screws and slide the assembly into the desired position and re-tighten the set screws.
    a. For optimal protection, the air knife should be positioned well below the cover slide assembly.

Figure 5.4 High-Power Air Knife Adjustment



5.2 Installing a Digital Camera

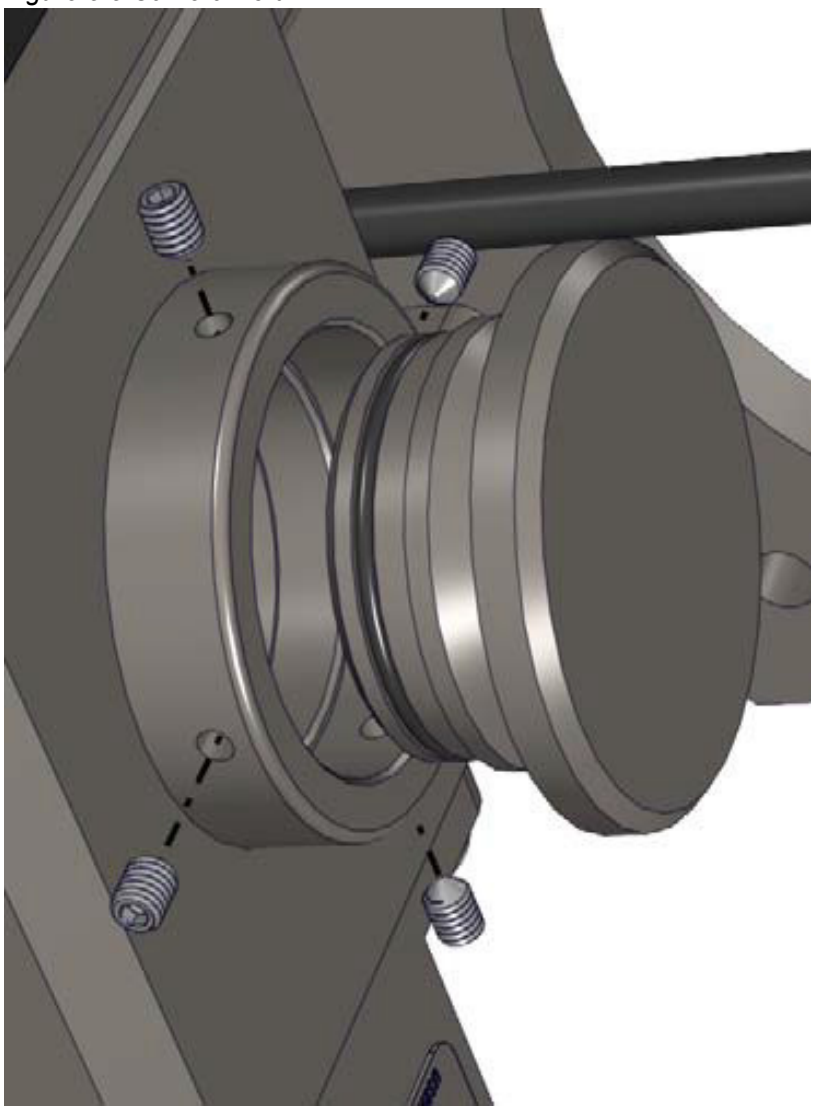
A digital camera provides co-axial vision of the workspace, which is useful for precisely aligning, previewing, and inspecting the workpiece.

For detailed information about your digital camera, refer to the accompanying product documentation.

To install a digital camera:

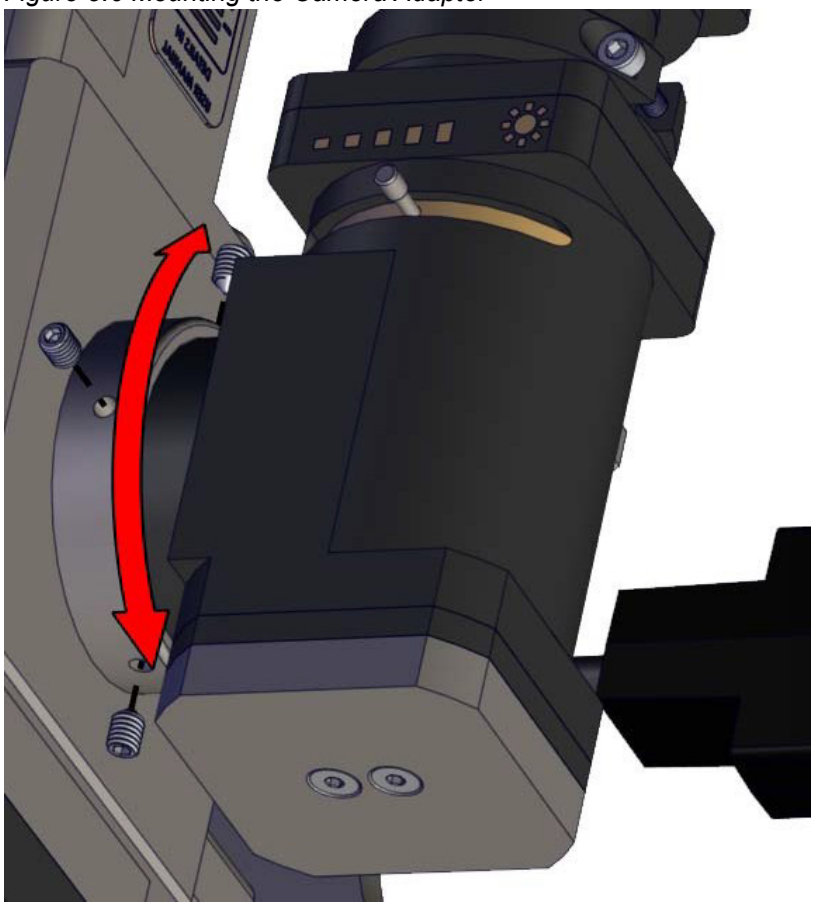
1. Loosen the four sets of screws of the scanning head camera post as shown in Figure 5.5.

Figure 5.5 Camera Port



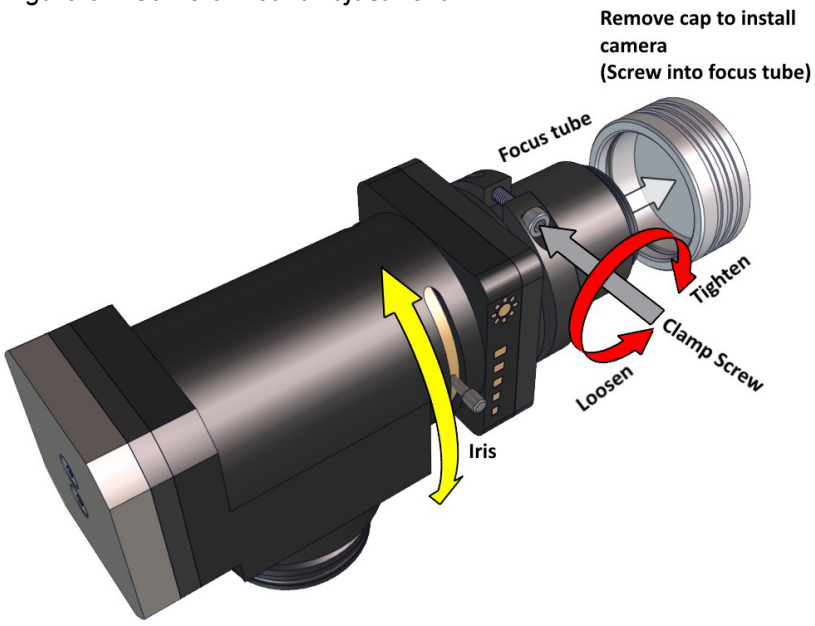
2. Remove the plug and store in a safe place.
3. Insert the camera arm into the open port. You can position the camera port in any direction as shown in Figure 5.6.

Figure 5.6 Mounting the Camera Adapter



4. Tighten the four set screws.
5. Remove the white cap on the camera to install it. Screw in a C-mount camera into the focus tube as shown in Figure 5.7.

Figure 5.7 Camera Mount Adjustment



6. Connect the power supply or POE to the interface on the camera.
7. Power on the camera.
8. Connect the Ethernet cable to the Ethernet interface on the camera.
9. Connect the Ethernet cable to the Ethernet interface to your computer, USB adapter, or hub.
    a. The Ethernet port on the camera and computer blinks to indicate the connection is successful.
10. Download the camera software from the vendor's website. You might also need to update the firmware for the camera. Make sure you have firmware version 201 installed.
    a. The HDMI camera package (P30-007443) does not require software. It simply plugs into a monitor or display.
    b. The HDMI camera cannot be used in the IPGScan Software
11. Run downloaded software in order to install the necessary device drivers. You might need to restart your computer afterwards.
12. See "Digital Camera Setup” in the IPGScan Manual.

6.0 Electrical Connections

The following sections outline the necessary electrical connections for the IPG Controller and the XY2-100 Connector.

6.1 IPG Controller Connections

Figure 6.1 IPG Controller Connection

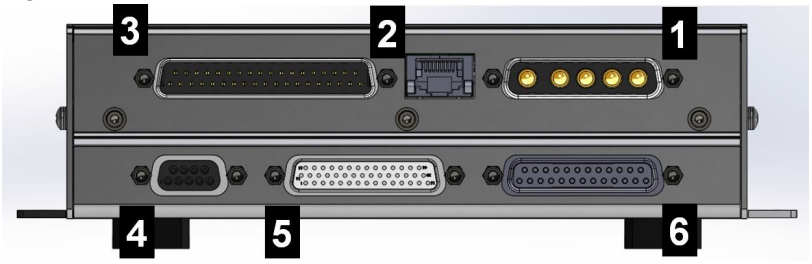


Table 6.1 IPG Controller Connections

Connector Number	Connector Type	Description
1	DB 5W5	Power Supply
2	RJ45	Ethernet Communications between Scan Controller and PC
3	DB37 Male	User I/O
4	DB9 Female	RS232 Serial Cable for controller communication
5	DB 44 Female	Digital communication with Scan head
6	DB15 or DB25 Female	Laser control interface. Connector is dependent on the laser model used with the scanner.

Each connection is described below in further detail.

6.1.1 Power Supply

The Scan Controller must be supplied with DC power in order to operate. Power is supplied to the controller through a DB 5W5 connector located on the posterior side of the Scan Controller.

Important **DO NOT CONNECT POWER SUPPLY RETURN TO EARTH GROUND!!!**

6.1.1.1 Power Pinouts

Figure 6.2 Male DB 5W5 Connector

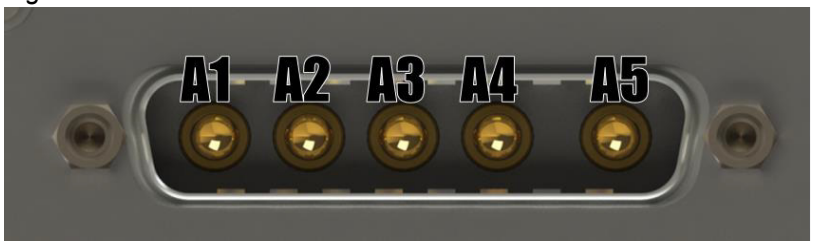


Table 6.2 IPG Scan Controller DB 5W5 Pinout

Pin	Function	Description
A1	Not Used	Do not connect this pin to ground.
A2	+V Laser HK	House Keeping Power 24V
A3	Return	Return for HK
A4	+V Scanner	Isolated Scanner Power (+V)-(-V) = 24V to 30V
A5	-V Scanner	

6.1.1.2 Power Requirements

Table 6.3 IPG Scan Controller Power Requirements

Pin	Function	Description
A1	Not Used	Do not connect this pin to ground.
A2	+V Laser HK	House Keeping Power 24V
A3	Return	Return for HK
A4	+V Scanner	Isolated Scanner Power (+V)-(-V) = 24V to 30V
A5	-V Scanner	

Note: Values are for IPG Controller. XY2-100 will be different depending on the controller.

Figure 6.3 Scanner to YLS Power Supply Configuration

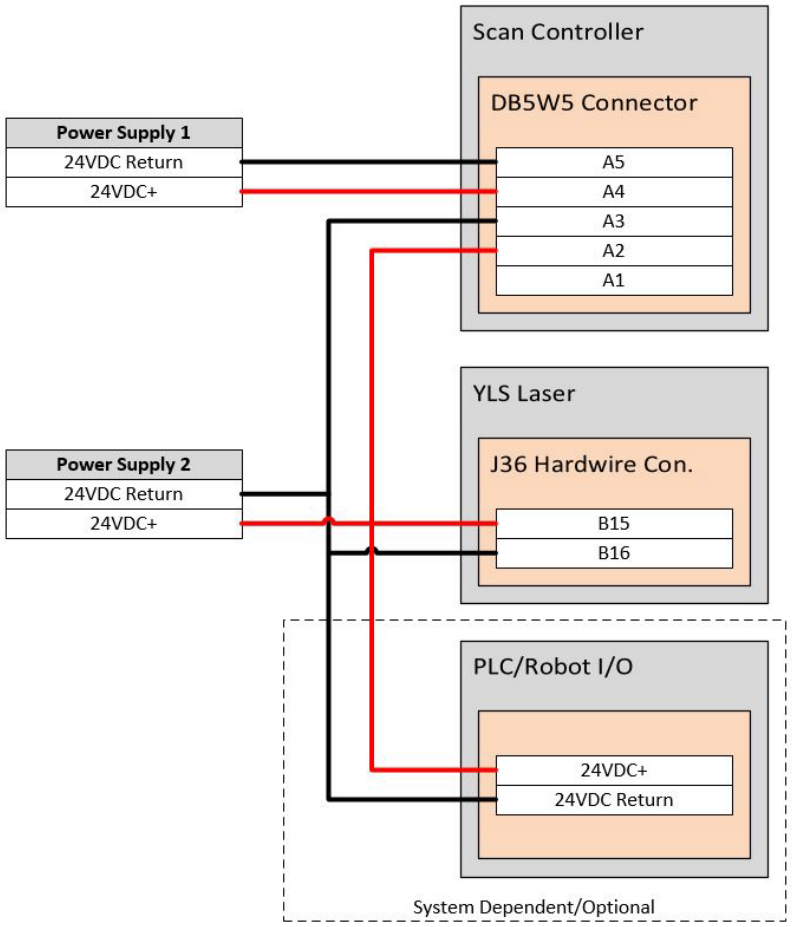
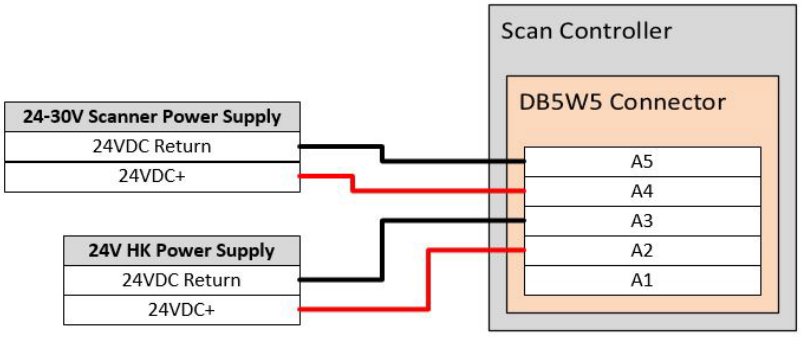


Figure 6.4 Scanner to YLR Power Supply Configuration



6.1.2 Ethernet

Used for all communication between Scan Controller and the host PC.

PC's Ethernet adapter should be initially configured for DHCP, however a static IP can also be used. IPG recommends a direct connection between the Scan Controller and PC, capable of 100Mbits/sec.

User has no access to the protocol data going through this line.

6.1.3 User I/O

User I/O is used for external control (hard wiring) of the Scan Controller. I/O signals out of this connector are either 3.3VTTL or RS422 compatible.

Bidirectional I/O signals are not isolated so IPG does not recommend direct connection with them, but only through a Motion Control Interface Board (P30-003779), or 24V Interface Board (P30-003943). Please see appropriate chapters for these interface boards.

Table 6.4 User I/O Pinout

Pin	Name	I/O, Interface Type	Description
1 20	Active GND	Out 3VTTL	Mark in Progress
2 21	Ready GND	Out 3VTTL	Ready/Waiting for Start
3 22	Error GND	Out 3VTTL	Error Condition
4 23	Start GND	In 3VTTL	Start Signal Input ,Internally pulled up to 3.3V
5 24	Stop_ GND	In 3VTTL	Stop Signal Input, Active Low Internally pulled up to 3.3V
6 25 7 26	GPIO[0] GPIO[2] GPIO[1] GPIO[3]	In/Out 3VTTL	General Purpose Input/Output for synchronization. Internally pulled up to 3.3V (PortA[3:0])1
8 27	BiDirectional I/O A1+ BiDirectional I/O A1-	In/Out RS-422	Axis A Phase A or SelectBit0 (PortA[16]) [1]
9 28	BiDirectional I/O B1+ BiDirectional I/O B1-	In/Out RS-422	Axis A Phase B or SelectBit1 (PortA[17]) [1]
10 29	BiDirectional I/O Z1+ BiDirectional I/O Z1-	In RS-422	Axis A Phase Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V) or SelectBit2 (PortA[18]) [1]
11 30	BiDirectional I/O A2+ BiDirectional I/O A2-	In/Out RS-422	Axis B Phase A or SelectBit3 (PortA[19]) [1]
12 31	BiDirectional I/O B2+ BiDirectional I/O B2-	In/Out RS-422	Axis B Phase B or SelectBit4 (PortA[20]) [1]
13 32	BiDirectional I/O Z2+ BiDirectional I/O Z2-	In RS-422 or 3VTTL	Axis B Phase Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V) or SelectBit5 (PortA[21]) [1]
14 33	BiDirectional I/O A3+ BiDirectional I/O A3-	In/Out RS-422	Axis C Phase A or SelectBit6 (PortA[22]) [1]
15 34	BiDirectional I/O B3+ BiDirectional I/O B3-	In/Out RS-422	Axis C Phase B or SelectBit7 (PortA[23]) [1]
16 35	BiDirectional I/O Z3+ BiDirectional I/O Z3-	In/Out RS-422 Or In 3VTTL	Axis C Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V), SelectBit8 (PortA[24]). Or ClkIn/ClkOut Differential for synchronization to laser. [1]
17 36	SBUSA+ SBUSA-	Serial Input	IPG Expansion Serial Bus
18 37	SBUSB+ SBUSB-	Serial Output	IPG Expansion Serial Bus
19	GND	Out	Logic Ground

1 Difference between Axis and Select Bit depends on the accessory board being used. Please reference section (motion control board) and (24V Interface board).

6.1.4 RS232 Serial

This connector is used as a monitoring/troubleshooting connection to the Scan Controller. It is usually used (with limitations) to communicate with the controller when the Ethernet connection is not available (for example, when IP address settings are incorrect, it can be used to reset the IP address back to DHCP).

Table 6.5 Serial Pinout

Pin	Description
1	Reserved – Do not connect
2	Input - Receive Data
3	Output - Transmit data
4	Reserved – Do not connect
5	GND
6	Data Set Ready – Internally connected to Pin 4
7	Request To Send – Internally connected to Pin 8
8	Reserved – Do not connect
9	Reserved – Do not connect

6.1.5 Scanner Control

This provides the connection between the Scan Controller and Scan Head. IPG provides the cable to be inserted here. Users are not allowed to interface with this connector.

6.1.6 Laser Control

This connection allows communication with the laser. This connector can be either a DB15 or a DB25 pin connector depending on the laser to be controlled.

The DB15 version has an analog power control signal and is used with YLS and YLR laser types. Refer to Table 6.6 for the corresponding D15 pinouts. The DB25 version has digital power control signals and is used with YLP lasers with a Type E interface. Refer to Table 6.7for DB25 connector pinouts.

Actual wiring between Scan Controller and laser source is shown in Section 7.0.

Table 6.6 DB15 Pinout

Pin	Direction	Description
1	Output	Analog Control +
9		Analog Control Return
2	Output	Modulation +
10		Modulation Return
3	Output	Guide Control
11	Output	Program Start/Emission Enable
4	Input	Power Supply Active
12	Input	Error/Ready
13	Input	Emission On
5, 7		System GND
6	Output	Gate

Table 6.7 DB25 Pinout

Pin	Name	Description
1-8	Power Setting	8-bit bus, range 0x00..0xFF (hex) or 0.255 (decimal). Least significant bit (lsb) (D0) corresponds to Pin number 1 Most significant bit (msb) (D7) corresponds to pin 8. 00h (0): Minimum output power FFh (255): Maximum output power
9	Latch	Latches power setting into the laser by the rising edge
10	AUX _IN 1	Reserved – Do not use
13	AUX _IN 2	Reserved – Do not use
11, 12, 16, 21	Alarm [3:0]	Laser alarm bits
14	GND	
15	5V Input	5V input – Not used
17	5V Output	5V for independent operation of guide laser
18	Emission Enable	Turn on emission enable (EE) signal on laser.
19	Emission Mod	Turn on emission modulation (EM) signal on laser.
20	Sync	Pulse Repetition Rate (Synchronization)
22	Guide Laser	Guide Laser (red diode) ON/OFF
23	Aux OFF	Auxiliary Emission OFF
24	AUX _IN 3	Reserved – Do not use
25	AUX _IN 4	Reserved – Do not use

6.2 XY2-100 Connector Description (Mid-Power Only)

Figure 6.5 XY2-100 Connectors

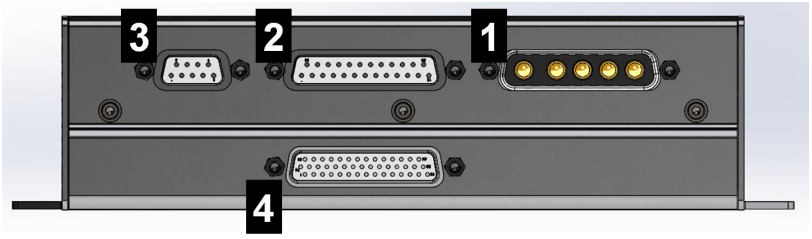


Table 6.8 XY2-100 In/Out Connector Descriptions

Connector Number	Connector Type	Description
1	DB 5W5 Male	Power Supply
2	DB25 Female	XY2-100 Digital Signals
3	DB9 Female	Auxiliary IO
4	DB44 Female	Scanner Controller

Each connection is described below in further detail.

6.2.1 Power Supply

The power connector is a DB 5W5, located on the Scan Controller and it is supplied with the scanner..

Important

POWER SUPPLY MUST HAVE A TRANSIENT RESPONSE TIME OF AT LEAST 2ms FOR A 50% LOAD CHANGE.

DO NOT CONNECT POWER SUPPLY RETURN TO EARTH GROUND.

6.2.1.1 Power Pinouts

Figure 6.6 Male DB 5W5 Connector

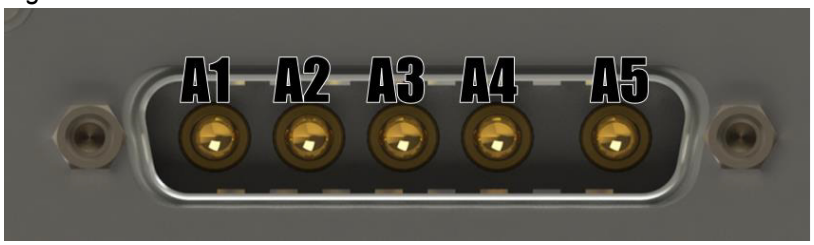


Table 6.9 XY2-100 DB 5W5 Pinout

Pin	Function	Description
A1	Not Used	Do not connect this pin to ground.
A2	+V Laser HK	House Keeping Power 24V
A3	Return	Return for HK
A4	+V Scanner	Isolated Scanner Power (+V)-(-V) = 24V to 30V
A5	-V Scanner	

6.2.1.2 Power Requirements

Table 6.10 XY2-100 Power Requirements

System	Function	Description
Controller HK	24V ± 5%	< 1A
Scanner	24-30V ± 5%	10A Peak - 2A Average

Note: Power for the scanner should be provided using the DB 5W5 connector. Do not supply power to the scanner using the XY2-100 Digital In/Out Pinouts connector.

6.2.2 XY2-100 Digital Signals

The following entails digital inputs and outputs for the XY2-100 signals from an external controller. Please see the XY2-100 specification for electrical specifications on these signals.

Figure 6.7 Scanner to YLS Power Supply Configuration

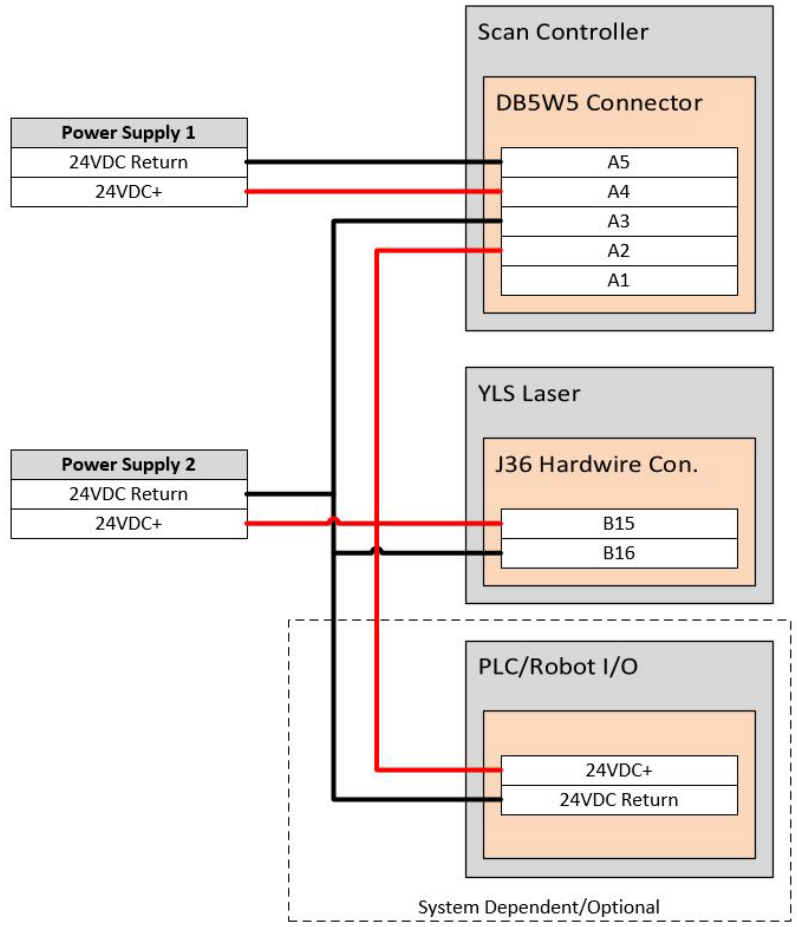


Figure 6.8 Scanner to YLR Power Supply Configuration

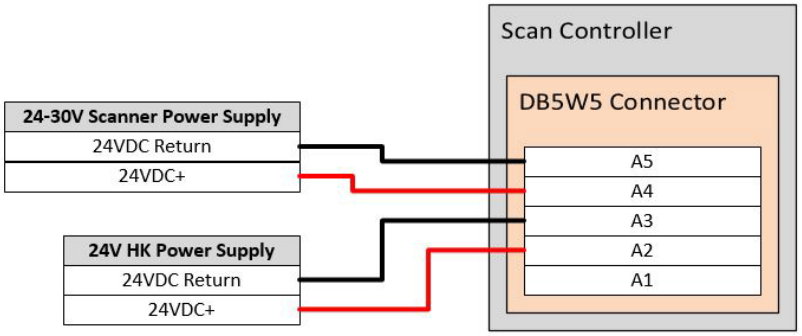


Table 6.11 XY2-100 Digital Signal Pinouts

Pin	Name	I/O	Description
1 14	CK- CK+	Input Input	2Mhz Clock
2 15	SYNC- SYNC+	Input Input	Sync Signal
3 16	XD- XD+	Input Input	X Channel Data
4 17	YD- YD+	Input Input	Y Channel Data
5 18	ZD- ZD+	Input Input	Z Channel Data (If Z axis Present)
6 19	STAT- STAT+	Output Output	XY2-100 Status Word
7 20	NC NC		No Connect
8 21	NC NC		No Connect
9 22 10	+V Servo	PWR	No Connect
23 11 24	GND	PWR	No Connect
12 25 13	-V Servo	PWR	No Connect

6.2.3 Auxiliary I/O

Table 6.12 outlines the auxiliary I/O pinouts on the XY2-100 interface.

Table 6.12 XY2-100 Auxiliary I/O Pinouts

Pin	Name	Description
1 6	A1 A2	Not used in this configuration
2 7	B1 B2	Not used in this configuration
3	GL_ON	Guide Laser On
8	GND	Guide Laser Signal Return
4	FL_ON	Focus Guide (if available)
9	GND	Focus Guide Return
5	NC	No Connect

6.2.4 Scanner Control

This provides the connection between the Scan Controller and Scanner Head. IPG provides the cable to be inserted here. Users are not allowed to interface with this connector.

7.0 Laser Connections and Configuration

7.1 Overview

The following diagrams outline the electrical interface/configuration for connecting a Scan Controller to the specified IPG laser model.

Important **This is not an all-inclusive list of required connections for setting up the laser. Users should refer to their lasers manual for pin-outs, safety connections, remote key switch connections, and sequencing diagrams specific to the operation of their laser.**

7.2 YLR Series Lasers

The following sections outline the setup between a YLR Series laser and an IPG Scan Controller.

7.2.1 Scan Controller to YLR Series Laser Connections

Please refer to Figure 7.1 for Scan Controller to YLR Series laser connections.

Figure 7.1 Scan Controller to YLR Laser Connections

Scan Controller	
DB15 Male	
Pin	Signal
1	Analog Control +
9	Analog Control Return
2	Modulation +
10	Modulation Return
3	Guide Control
11	Emission Enable
4	Power Supply Active
12	Error/Ready
5	System GND
13	Not Used
6	Not Used
14	Not Used
7	Not Used
15	Not Used
8	Not Used

YLR Laser	
24 Pin Harting Connector	
Pin	Signal
12	Analog Input +
14	Isolated Analog Return
15	Modulation +
16	Modulation Return
17	Guide Control
18	Emission Enable
23	Power Supply Active
19	Error/Ready
20	System Common

Input
Output

7.2.2 YLR Laser Source Setup

Prior to processing, YLR Series lasers must be setup for the desired mode of processing. The following procedures outline the steps for setting up a YLR-Series laser in QCW mode or CW mode.

For more specific details on laser operation, please refer to the manual provided with the laser.

CW Mode

1. Turn the key switch on the laser to **ON**.
2. Using the touch screen, set the laser to **CW**.
3. Enter the **Setup** menu and set the following parameters as detailed.
    a. Gate: Disabled
    b. Ext. Emission Control: ON
    c. Ext. Guide Control: ON

d. Modulation: ON
e. Analog Control: ON

4. Press the **Return** button.
5. Turn the key switch on the laser to **REM**.

QCW Mode

6. Turn the key switch on the laser to **ON**.
7. Using the touch screen, set the laser to Q**CW**.
8. Enter the **Setup** menu and set the following parameters as detailed.
   a. Gate: Disabled
   b. Ext. Emission Control: ON
   c. Ext. Guide Control: ON
   d. Modulation: ON
   e. Analog Control: ON
9. Press the **Return** button.
10. Turn the key switch on the laser to **REM**.

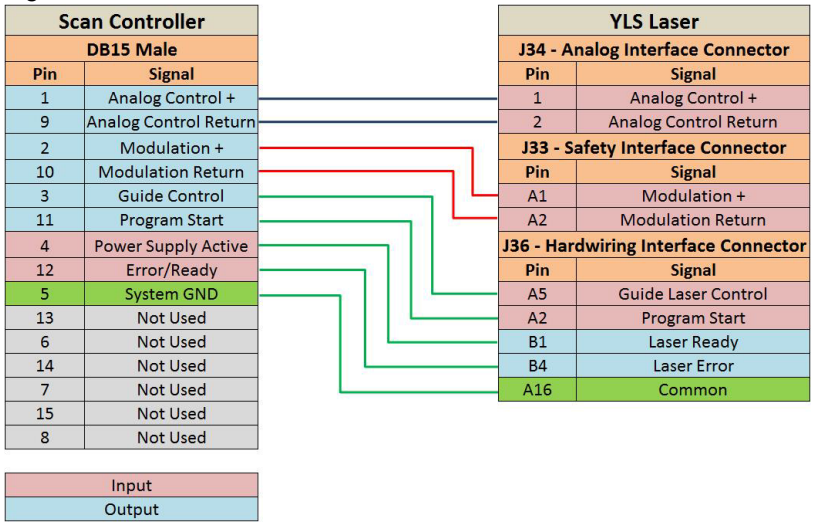
7.3 YLS Series Lasers

The following sections outline the setup between a YLS Series laser and an IPG Scan Controller.

7.3.1 Scan Controller to YLS Series Laser Connections

Please refer to Figure 7.2 for Scan Controller to YLS Series laser connections.

Figure 7.2 Scan Controller to YLS Laser Connections



Important **Laser Error Signal: Users who have previously integrated IPG Lasers may be custom to using the Laser Error signal for PLC/System logic. If users would still prefer to do this, please contact an IPG Product Specialist.**

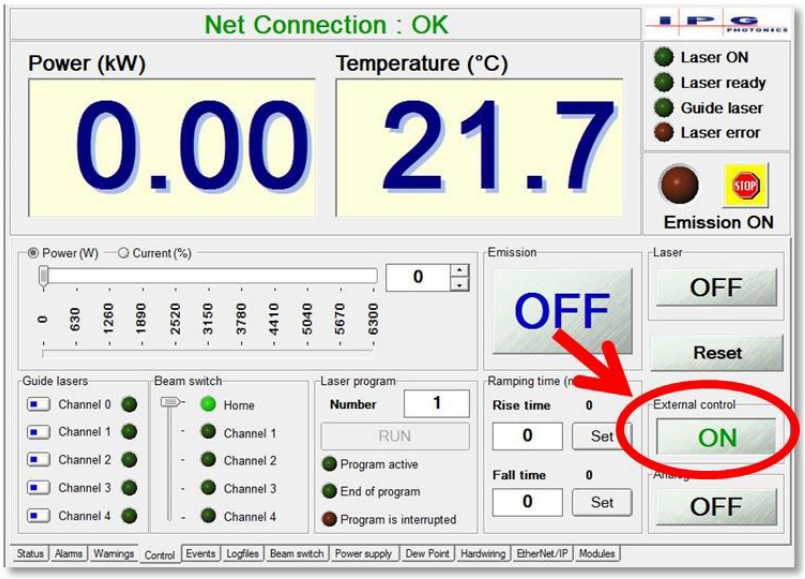
7.3.2 YLS Laser Source Setup

Prior to processing, YLS Series lasers must be setup for the desired mode of processing. The following procedures outline the steps for setting up a YLS Series laser.

For more specific details on laser operation, please refer to the manual provided with the laser.

1. Turn the key switch on the laser to **ON**.
2. In LaserNet, open the **Control Tab**.
3. Click "**External Control**" button. It should now read **ON**. See Figure 7.3.
4. Turn the key switch on the laser to **REM**.

Figure 7.3 YLS External Control On



8.0 Motion Interfaces

IPG remote processing heads can be utilized with a number of motion interfaces. Examples of motion interfaces include linear stages, rotary axes, gantries, and robots.

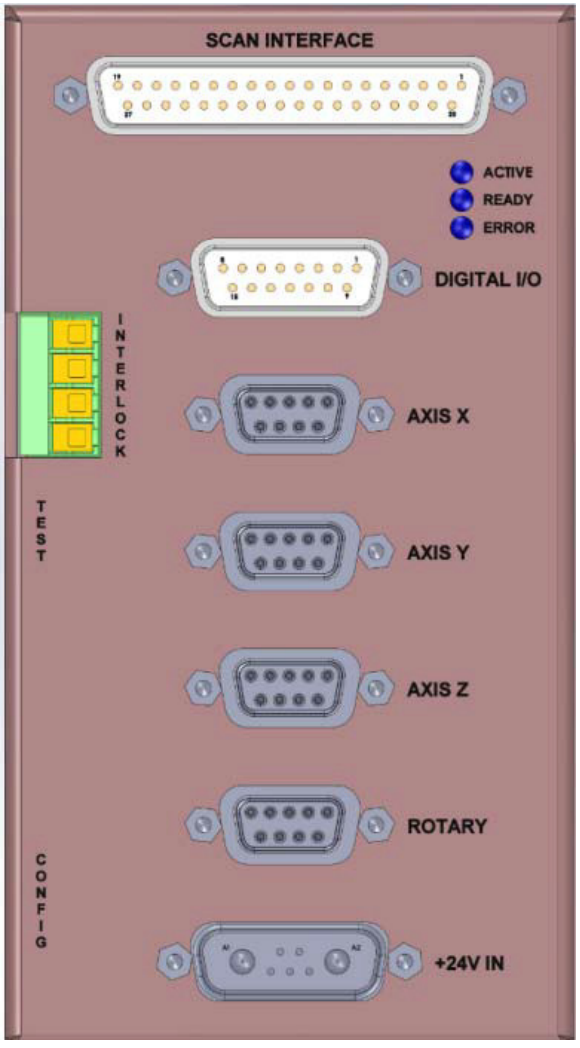
The following sections outline the Motion Control Interface (typically used for stages, rotaries, and gantries) and the 24V Interface(typically used for robots/PLC).

8.1 Motion Control Interface

The 5V I/O interface (Motion Control Interface) allows the Scan Controller to work with common types of motor drivers, such as a Gantry overhead lift structure.

Figure 8.1 shows the Motor Control Interface front view.

Figure 8.1 Motor Control Interface Front View



8.1.1 Motor Control Interface Descriptions

Table 8.1 provides descriptions of each motor control interface.

Table 8.1 Motor Control Interface Connections

Item	Component	Description
1	Scan Interface DB 37-pin Female Socket	Used for external interface to the 37-pin Male interface on the controller box rear panel.
2	Digital I/O DB 15-pin Female Socket	The Digital I/O is a 15-pin female interface that connect to the 37-pin interface and is isolated and at 5V logic levels.
3	Fiber Interlock DB 9-pin Female Socket	Brings the fiber interlock signals from the scan controller out to screw taps.
4	Motor Controller I/O - P1,P2, P3 DB 9-pin Female Sockets (Axis X, Y, Z)	This connector interfaces with a Motor Control to drive a stage. There are three connectors with identical pinouts intended for XYZ control. You can configure the connectors to drive or receive signals at 5V logic (can be single-end or differential).
5	Motor Controller I/O - Axis R DB 9-pin Female Socket	This connector is multiplexed with P2 Y axis. Depending on the logic level of P4-4 (normally high), you can enable the use of P2 or P4 signals. The Y axis signals or the Rotary axis signals are mutually exclusive. The Y axis is typically enabled. Pulling P4-4 to GND enables the Rotary axis and disables the Y axis.
6	Power Supply +24V IN 7 (5 + 2 Power) Position D-Sub, Combo Receptacle, Female Socket Connector, NOR1336-ND	+24V power supply for board.

8.1.2 Scan Interface

Table 8.2 provides details for the 37-pin socket.

Table 8.2 Motor Control Scan Interface Pinouts

Pin	Name	I/O	Description
1	Active	Out	Mark in Progress
20	GND	3VTTL	
2	Ready	Out	Ready/Waiting Signal
21	GND	3VTTL	
3	Error	Out	Error Condition
22	GND	3VTTL	
4	Start	In	Start Signal Input
23	GND	3VTTL	Pulled up to 3.3V
5	Stop	In	Stop Signal Input Active Low
24	GND	3VTTL	Pulled up to 3.3V
6	GPIO[0]	In/Out	General Purpose Input/Output for Synchronization
25	GND	3VVTL	Pulled up to 3.3V
7	GPIO[1]	In/Out	General Purpose Input/Output for Synchronization
26	GND	3VVTL	Pulled up to 3VVTL
8	A_Axis_A+	In/Out	Axis A Phase A
27	A_Axis_A-	RS-422	
9	A_Axis_B+	In/Out	Axis A Phase B
28	A_Axis_B-	RS-422	
10	A_Axis_Z+	In	Axis A Phase Home (or Zero) Differential or Single
29	A_Axis_Z-	RS-422	Ended (on Z+ Pulled up to 3.3V)
11	B_Axis_A+	In/Out	Axis B Phase A
30	B_Axis_A-	RS-422	
12	B_Axis_B+	In/Out	Axis B Phase B
31	B_Axis_B-	RS-422	

8.1.3 Digital I/O Interface

Table 8.4 provides details on the digital I/O signals that connect to the 15-pin interface and are isolated at 5V logic levels.

Table 8.3 Motor Control Digital I/O Interface Pinouts

Pin	Name	I/O	Description
1	GND		
2	Stop	Input	Stop signal input, active low. Pulled up to +5V
3	Ready	Output	Ready, waiting for start
4	GPIO[0]	Input	If pin 6 on DB37 is an input, use this pin. Must configure SW3-1 for input. Pulled up to +5V
5	GND		
6	GPIO[1]	Output	If pin 7 on DB37 is an output, use this pin. Must configure SW3-2 for output
7	GND		
8	GND		
9	Start	Input	Start signal input. Pulled up to +5V
10	Active	Output	Mark in progress.
11	Error	Output	Error condition.
12	GPIO[1]	Input	If pin 7 on DB37 is an input, use this pin. Must configure SW3-2 for input. Pulled up to +5V
13	GPIO[0]	Output	If pin 6 on DB37 is an output, use this pin. Must configure SW3-2 for output.
14	ROTARY_SELL	Input	Pulled up to +5V. When this signal is high, the Y axis is enabled; when it is low, the Rotary axis is enabled. Can be driven by GP0/1 if configured.
15	GND		

8.1.4 MotorControl I/O - P1, P2, P3

Table 8.4 provides details for the 9-pin sockets.

Table 8.4 Motor Control I/O Pinouts

Pin	Name	I/O	Description
5	AXIS_IO0+	IO	Can be a 5V command or encoder feedback (SE or Differential) depending on SW1.
9	AXIS_IO0-		Only used if differential signal is needed.
4	GND		
8	AXIS_IO1+	IO	Can be a 5V command or encoder feedback (SE or Differential) depending on SW1.
3	AXIS_IO1-		Only used if differential signal is needed.
7	GND		
2	Home_sensor+	Input	Home sensor input. Can be SE or differential depending on SW1.
6	Home_sensor-	Input	Only used if differential signal is needed.
1	GND		

8.1.5 Motor Control Inputs - Axis X, Y, and Z

Table 8.5 provides details for the 9-pin female sockets.

This connector is multiplexed with P2 Y axis. Depending on the logic level of P4-4 (normally high) you can enable the use of P2's signals or P4's. The Y axis signals or the Rotary axis signals are mutually exclusive. The Y axis is enabled normally; pulling P4-4 to GND will enable the Rotary axis and disable the Y axis.

The Rotary axis can only send commands; it cannot be used to read encoder feedback

Table 8.5 Motor Control Inputs Pinouts

Pin	Name	I/O	Description
5	ROTARY_IN0+	Input	Can be a 5V command (SE or Differential) depending on SW4
9	ROTARY_IN0-		Only used if differential signal is needed
4	GND		
8	ROTARY_IN1+	Input	Can be a 5V command (SE or Differential) depending on SW4
3	ROTARY_IN1-		Only used if differential signal is needed
7	GND		
2	Home_sensor+	Input	Home sensor input. Can be SE or differential depending on SW4
6	Home_sensor-	Input	Only used if differential signal is needed
1	GND		

8.1.6 Fiber Interlock Inputs

Table 8.6 provides details for the 9-pin sockets.

Table 8.6 Fiber Interlock Pinouts

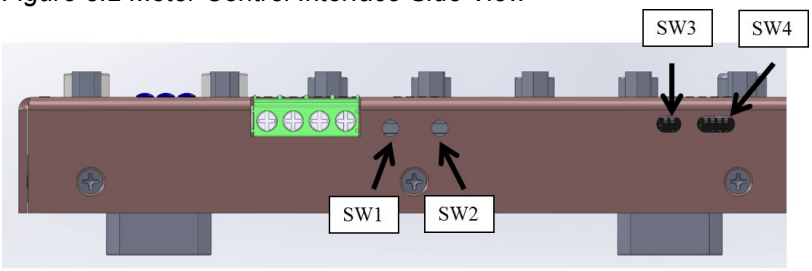
Pin	Name	I/O	Description
1	INTLK_A0	Out	Fiber Interlock is Safe when 1 connected to 0.
2	INTLK_A1		
3	INTLK_B0	Out	Fiber Interlock is Safe when 1 connected to 0
4	INTLK_B1		

8.1.7 Configuration and Testing

There are two sets of DIP switches used to configure the board. You can use the two contact push-buttons to test the Start and Stop operations.

Figure 8.2 shows the Motor Controller Interface side view.

Figure 8.2 Motor Control Interface Side View



SW1 and SW2 - Pushbutton Test Signals

SW1 - When pressed, the Start signal is low. Normally high.

SW2 - When pressed, the Stop signal is low. Normally high.

SW3 - PIO[0], GPIO[1] Direction

The switch is marked with an arrow pointing down that is labeled "ON." When the DIP switch is pointed down, it is in the ON position. When it is pointed up, it is in the OFF position.

Position 1 – This switch sets pin 6 of the 37-pin DSUB (J1-6) as an input or output.

- ON - GPIO[0] is an input. Send a 5V signal to J2-4.
- OFF - GPIO[0] is an output. J2-13 can drive a 5V signal to a controller.

Position 2 – This switch sets pin 7 of the 37-pin DSUB (J1-7) as an input or output.

- ON - GPIO[1] is an input. Send a 5V signal to J2-12.
- OFF - GPIO[1] is an output. J2-6 can drive a 5V signal to a controller.

SW4 - Encoder Interface Setup - SW4

The switch is marked with an arrow pointing down that is labeled "ON." When the DIP switch is pointed down, it is in the ON position. When it is pointed up, it is in the OFF position.

Position 1 - This switch sets up the home sensor as differential or single- ended when toggled.

- ON - Home sensor is a single-ended signal connected to pin 2 of P1, P2, P3, or P4.
- OFF - Home sensor is a differential signal connected to pin 2 and 6 of P1, P2, P3, or P4.

Position 2 - This switch sets up the encoder signals as differential or single-ended when toggled.

- ON - Encoder signals are single-ended.
- OFF - Encoder signals are differential.

Position 3 - This switch determines the direction of the encoder signals.

- ON - Encoder commands are sent to the DB9 connectors to control a motor driver.
- OFF - Encoder signals are read back to the DB9 connectors so the IPGP523 can monitor stage locations.

The rotary axis cannot be used if Position 3 is in the OFF position. Position 4 - Reserved

8.2 24V Robot Interface

The 24V Interface Board is required to connect the signals from the robot to the Scan Controller. The part number is: P30-003943. The board is designed for active high sourcing outputs and active high sinking inputs.

Figure 8.3 24V Interface Board

Table 8.7 provides the specifications for the 24V Interface Board.

Table 8.7 24V Interface Board Specifications

Item	Description
Input Voltage	24VDC
Input Current	0.1A
Signal Level Inputs	24V 10K Ohm Input Resistance
Signal Outputs	24V Totem Pole; 50mA max; 25 Ohm Output Resistance
Isolation	1000V Robot to Scan Controller
Mounting	Spring loaded DIN Rail
Scan Controller Interface	37-pin D-Sub Cable
Robot Interface	Weidmuller 1729680000

8.2.1 Robot Interface Signals

The following table outlines the signals that are required for the robot and Scan Controllers to communicate for processing.

Important **Signals are described in terms of IPG Scan Controller (Input to Scan Controller / Output from Scan Controller)**

Table 8.8 24V Interface Board Signals

Pin	Signal Name	Input/Output	Description
1	GND		Robot/PLC signal ground reference and power return.
2			
3	SELECT 0	INPUT	Selection bits used to choose the upcoming IPGScan group.
4	SELECT 1	INPUT	
5	SELECT 2	INPUT	
6	SELECT 3	INPUT	
7	SELECT 4	INPUT	
8	SELECT 5	INPUT	
9	SELECT 6	INPUT	
10	SELECT 7	INPUT	
11	SELECT 8	INPUT	
12	STROBE	INPUT	Indication that the Select bits are ready to be read.
13	GND		Robot/PLC signal ground reference and power return.
14			
15	READY	OUTPUT	Data is ready. Ok to start processing.
16	ACTIVE	OUTPUT	Job is in process. Inactive when there is no job ready or running.
17	START	INPUT	Signal to start running the current IPGScan job.
18	ERROR	OUTPUT	An error has occurred.
19	ENABLE	INPUT	Enable operation of the Scanner. Must be set high when previewing with the guide laser and during processing.
20	GPO1	OUTPUT	General Purpose Output Signal. Can be used for additional interfacing requirements. This signal is an output from the Scan Controller and an input to the robot/PLC.
21	+24V Input		Power input.
22			
23	GND		Robot/PLC signal ground reference and power return.
24			

9.0 Maintenance

9.1 Overview

The Mid and High-Power Scanners are incorporated into a given fixed installation. The safety functions should be tested in a defined periodic maintenance interval.

The time cycle of this interval is dependent on the safety analysis of the system where the scanners are installed.

Only personnel knowledgeable in the related functional safety assessment of the system should determine such maintenance.

9.2 Water Treatment and Corrosion Prevention

In order to maintain proper working order of the IPG Scanners, it is important to maintain and treat the water used for cooling the optics. The following documents must be followed in order to maintain proper functioning of the scanners.

- IPG Water Treatment Kit Procedure
- Water Treatment Kit Instruction Sheet

Please contact your Sales Representative or service@ipgphotonics.com for such documents.

9.3 Replacing the Protective Window

After repeated usage, the protective window can become dirty or damaged which, ultimately, affects the beam quality. For Mid and High-Power Scanners, the window sub-assembly contains 2 individual glass elements. Generally, the outer element will become dirty or damaged before the inner element. However, both are replaceable as required.

Note: Replacement of protection windows requires disassembly and assembly to be performed in a dust free environment with appropriate handling and cleaning supplies for optics.

To remove the protective window sub-assembly:

1. Rotate the window assembly on the scan head counter-clockwise (if looking up at the scanner) to remove it from the focus lens assembly as shown in Figure 9.1 and Figure 9.2.

Figure 9.1 Window Assembly Release Position

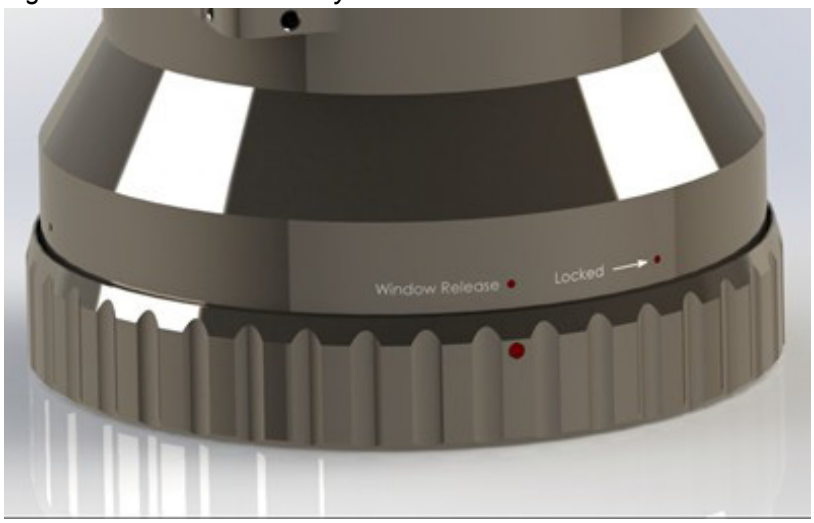
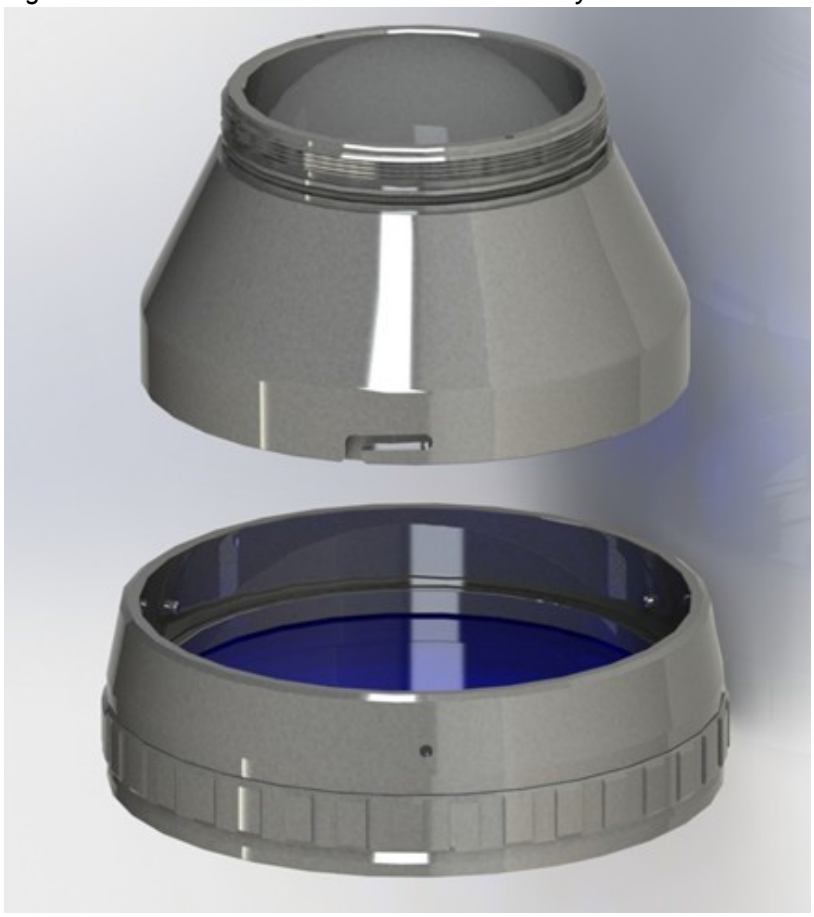


Figure 9.2 Removing the Window Assembly

2. Using a hex driver, remove the screws to release the protective window retaining ring and window glass.
3. Insert the replacement protective window glass into the frame. Be sure that the sealing O-rings are properly seated.
4. Replace the retaining ring and fasten the screws back into the frame.
5. Replace the protective window sub-assembly by aligning the pins and grooves and rotating it clockwise. Observe marking on the High-Power lens assembly for proper alignment, as shown in Figure 9.3.

Figure 9.3 Mid-Power Scanner Window Assembly Removal



9.4 Spare Parts List

The following sections outline specific product part numbers that the user may want to keep on hand for maintenance or repairs.

This is not an exhaustive list of system components and the user should review their application for a complete list of spare part/maintenance items. Additionally, on hand quantity should be considered by the customer and tailored to the specific application.

Important **Lead Times: The approximate lead time of the following items is 2-3 weeks.**

9.4.1 2D High-Power Scanner

Table 9.1 outlines maintenance and spare parts for the 2D High-Power Scanner.

Table 9.1 2D High-Power Scanner Maintenance and Spare Parts

Description	Part Number	Recommended On Hand Quantity
Additional 2D HP Window Assembly	P30-007866	1-2 (dependent on number of systems)
Window (Cover Slides)	P45-012989	4-5 per head
Window O-Ring	P40-005341	1-2 per head
**Protective Window Cover (One ships with each head)	P45-017834	1 per head
3m Control Cable	P30-007949	1 of the proper length
5m Control Cable	P30-101126	
Motion Control Board	P30-003779	1 (choose the board specific to your application)
24V Robot Interface	P30-003943	
90° Water Fitting (M5)	P30-003658	2 per head

**This is simply for protecting the cover-slide if the head ever needs to be taken down or stored. It is not production critical.

9.4.2 2D Mid-Power Scanner

Table 9.2 outlines maintenance and spare parts for the 2D Mid-Power Scanner.

Table 9.2 2D Mid-Power Scanner Maintenance and Spare Parts

P30-010226 Mid-Power Head		
Description	**Part Number**	**Recommended On Hand Quantity**
Window - F100 & F163 (Cover Slides)	P45-019367	2-3 per head
Window - F254 (Cover Slides)	P45-019368	2-3 per head
Window - F330(Cover Slides)	COLFXXX3000012PX	2-3 per head
Window - F420 (Cover Slides)	COLFXXX3000013PX	2-3 per head
Window - F160 & F254 Fused Silica (Cover Slides)	P45-012603	2-3 per head
Window O-Ring	P40-019017	1-2 per head
**Protective Window Cover (One ships with each head)	P45-013007	1 per head
Control Cable	P30-007795	1
Motion Control Board	P30-003779	1 (choose the board specific to your application)
24V Robot Interface	P30-003943	
90° Water Fitting (M5)	P40-002251	2 per head
P30-010300 Mid-Power Head with Collimator Input		
Description	**Part Number**	**Recommended On Hand Quantity**
Window - F100 & F163 (Cover Slides)	P45-019367	2-3 per head
Window - F254 (Cover Slides)	P45-019368	2-3 per head
Window - F330 (Cover Slides)	COLFXXX3000012PX	2-3 per head
Window - F420 (Cover Slides)	COLFXXX3000013PX	2-3 per head
Control Cable	P30-007795	1

10.0 Applications

10.1 Introduction

IPG remote processing heads are powerful and efficient tools that can be applied to a range of applications. Thanks to the versatility of the IPG scanners, they can be utilized in a number of different manners in order to most effectively complete the task at hand. Whether the application involves welding, marking, ablation, or cutting (thin foils), IPG's scanners have been proven time and again.

The following information outlines example applications that are commonly found with remote scanning processes. While IPG scanners are intended to be used for numerous types of processing, this section aims to provide users with a sense of direction of how their process will be setup. This section is not focused specifically on welding, marking, or any other singular type of processing, but is intended to provide insight for setting up methods of processing such as Standalone processing, Point and Shoot processing, and On-The-Fly processing. Additionally, this guide seeks to provide different but common examples of the varying types of equipment that are often incorporated into a scanning system.

Although this section aims to provide users with a direction for application setup with an IPG scanner, it should not be viewed as an end-all-be-all. Please refer to product specific documentation in order to ensure that specific application needs are met.

10.2 Overview

The following sections outline example systems for differing applications. The goal of these sections is to provide users with a better understanding of what a functional IPG Scanner system may consist of for a particular application.

The following application/system examples may not provide details on all necessary components for a given application (i.e. air knifes, I/O quantities, etc.). Additionally, these examples may contain details on components that are not required in certain applications. For these reasons, it is always best to consult with a Sales Representative or Product Specialist in order to determine what all is needed for the application.

10.2.1 System Recommendations

IPG Photonics recommends the following for a scanner setup:

- Safety switch
- Windows Based PC (required for programming and processing)
- Linear stage positioners, gantry positioners, robots, or a simple stand to hold and/or position the scanner
- Fume extraction system to remove gases and particles released during the process

10.2.2 Recommended List of Equipment

Every application is unique and requires in depth review in order to select the proper equipment. Although each application should be tailored to its specific needs, the following list of items, Table 34, consists of equipment that is often required to make up a complete IPG Scanner System. Keep in mind, not all equipment provided on this list is required. Additionally, other equipment not included in this list may be required for given applications.

Table 10.1 Recommended List of Equipment for Scanning System

Item	Description	Supplier
Scanner Equipment		
Scanner & Scanner Controller	3D / 2D High-Power Scanner / Mid-Power Scanner	IPG Photonics
Air Knife (Cover Slide Protection)	For protecting coverslides during processing	IPG Photonics
Air Knifes (Plume Suppression)	Aids with process control/stability. Often mounted to fixturing.	IPG and Non-IPG Suppliers
24V Power Supplies	For power to Scanner, Scanner Controller, and Laser Outputs	Non-IPG Suppliers
Mounting Adapters (Scanner and Scanner Controller)	Mounting adapter for desired mount location.	Non-IPG Suppliers
Communications/Programming Equipment		
Computer	Required for scanner operation	Non-IPG Suppliers
Discrete Digital Inputs and Outputs	Active high. See individual application examples for required quantities.	Non-IPG Suppliers
24V Interface Board	Typically used with Robotic/PLC communication applications	IPG Photonics
Motion Control Interface	Typically used with motor driver applications.	IPG Photonics
***Cables/Connectors**		
Power	For providing power to Scanner and Scanner Controller	Customer supplied (connectors are included)
Scanner Interface Cable	Supports communication between Scanner and Scanner Controller. 3m Standard. 5m available for purchase.	IPG Photonics (3m standard comes with purchase of Scanner)
Scanner Controller to Laser Interface Cable	Supports communication between Scanner Controller and Laser.	Customer supplied. (laser connectors come with laser)
Ethernet Cable	Supports communication between computer with IPGScan and Scanner Controller.	Non-IPG Suppliers
Motion Control Cables	Supports communication between Scanner Controller, 24V Interface or 5V Interface, and motion device.	Customer/Non-IPG Supplier

*Customer supplied cables may require the purchase of some connectors depending on the application/equipment setup.

Customers should also consult with IPG Sales Representatives and Product Specialists for additional details on application needs.

See the IPG Photonics High-Power Scanners Brochure for part numbers and additional product detail.

10.3 Standalone Scanning System (No motion control)

Although this is not as frequently encountered as Point and Shoot processing, a standalone scanning system is sometimes desired. One such application that users may want a standalone system is for research and development. With this type of setup, the user is limited to running the scanner though a computer. Because the scanners have a large processing window, sometimes motion is not required. Such a system allows users to quickly and effectively perform process development while keeping the system relatively simple.

10.3.1 Standalone Scanning System Example

Equipment:

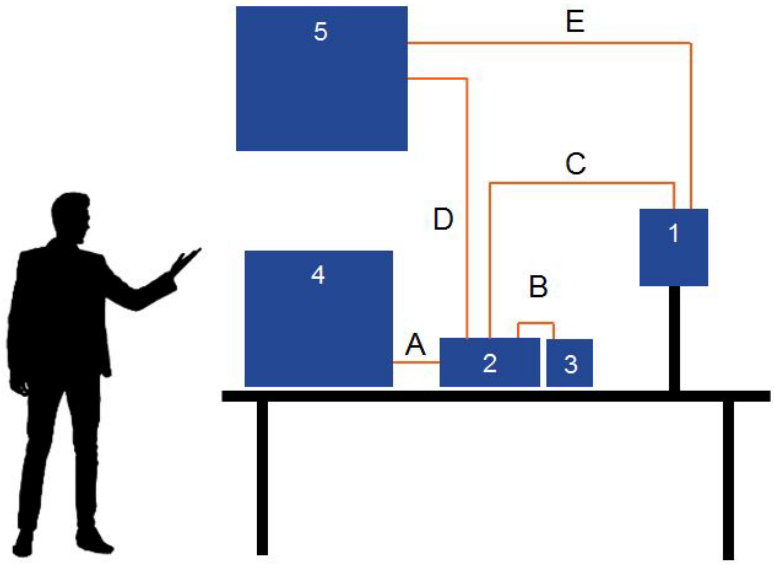
1. Scanner
2. Scan Controller
3. 24V Power Supply
4. Computer

5. Laser

Cable

A. Computer to Scanner Controller
B. 24V Power Supply to Scanner Controller
    - Should not exceed 15ft with 16 AWG
C. Scanner Controller to Scanner
    - 3m standard / 5m available for order
D. Scanner Controller to Laser
E. Process Fiber

Figure 10.1 Scanning System Example Diagram



10.4 Point and Shoot Processing

Point and shoot processing provides users with a reliable and robust process that has been proven throughout the laser industry for years.

Generally, a Point and Shoot process consists of an optic motion device (Robot or Gantry) that can position the scanner into desired locations for processing (Welding, Marking, Ablating). Components that are often manufactured with this type of technology include door frames, seat components, and anything in need of coating removal.

The following sections provide example layouts, process requirements for both hardware and interfacing, and any additional information that may pertain to the process.

10.4.1 Robotic Point and Shoot Processing

10.4.1.1 Robotic Point and Shoot Example System

Equipment:

1. Scanner
2. Scan Controller
3. 24V Power Supply
4. 24V Robot Interface

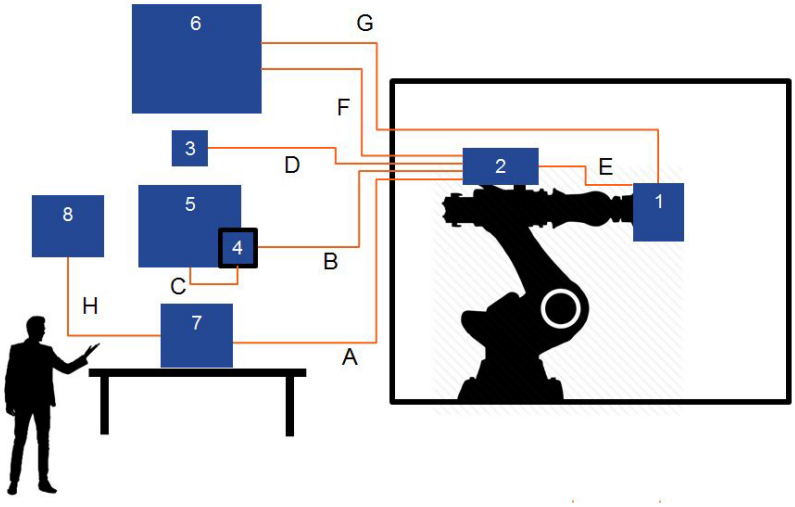
- Ideal to mount near the discrete digital IO

5. Discrete Digital IO
   - Typically in robot controller cabinet
6. Laser
7. Computer
8. PLC (Optional)
   - Could be used to send part #'s and dates for output as well as program names over Ethernet or Serial

Cables:

A. Computer to Scan Controller
B. 24V Interface to Scan Controller
C. 24V Interface to Discrete Digital IO
D. 24V Power Supply to Scan Controller
   - Should not exceed 15ft with 16 AWG
E. Scan Controller to Scanner
   - 3m standard / 5m available for order
F. Scan Controller to Laser
G. Process Fiber
H. PLC to Computer Ethernet/Serial Cable (Optional)

Figure 10.2 Robotic scanning System Example Diagram



10.4.1.2 Hardware

In addition to the outlined items in Table 10.1, Table 10.2 outlines the required number of I/O and the proper motion control interface.

Table 10.2 Required Hardware - Point and Shoot Processing

No.	Item	Description
1	24V Digital Outputs	12 outputs are required (active high).
2	24V Digital Inputs	2 inputs are required, 4 inputs can be used (active high).
3	24V Interface Board	IPG part number P30-003943. Interface between robot signals and scanner signals. Cables between robot I/O, interface board, and scan controller are supplied by the customer.

10.4.1.3 Point and Shoot Programming

Please refer to the IPGScan Manual for additional information on Scanner Programming and timing diagrams.

10.5 On-The-Fly (OTF) Processing

On-The-Fly processing is becoming more prevalent in today's manufacturing environment. Although it may not be as proven of a process as Point and Shoot processing, sometimes it is required in order to meet challenging cycle time requirements.

This process is similar to Point and Shoot processing in that the optics are manipulated by a motion device such as a robot or gantry; although instead of stopping motion before processing begins, the Scanner processes while in motion.

The following sections provide examples and details relating to process requirements for On-The-Fly processing.

10.5.1 Robotic On-The-Fly Processing

10.5.1.1 Robotic On-The-Fly Example System

Please refer to the example in Section 10.4.1.1 for a system layout.

10.5.1.2 Hardware

In addition to the outlined items in Table 10.2, Table 10.3 outlines the required number of I/O and the proper motion control interface.

Table 10.3 Required Hardware - Robotic On-The-Fly Processing

No.	Item	Description
1	24V Digital Outputs	2 digital outputs required (active high). For Enable & Start pins on 24V Robot Interface Board
2	24V Interface Board	IPG part number P30-003943. Interface between robot signals and scanner signals. Cables between robot I/O, interface board, and scan controller are supplied by the customer.

Important **Sometimes users will use a PLC as a pass-through for digital signals. This is acceptable in most cases but will result in inconsistent process timing with On-The-Fly processing. DO NOT RUN THE START BIT FROM THE ROBOT, THROUGH A PLC, TO THE 24V INTERFACE BOARD. IT SHOULD BE A DIRECT DISCRETE IO CONNECTION FOR CONSISTENT PROCESS TIMING.**

10.5.1.3 Optional Connections

Because digital I/O is relatively cheap and easy to setup, it never hurts to configure the system so it has the ability to process with Point and Shoot. This would entail using 12 digital outputs and 4 digital inputs instead of the outlined quantities in Table 10.3. Refer to Table 10.2 for Robotic Point and Shoot required hardware, which will allow the use of On-The-Fly processing.

10.5.1.4 On-The-Fly Programming

Please refer to the IPGScan Manual for additional information on scanner programming, additional robot requirements, and setup.

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Shipping address for returns to US:

> IPG Photonics Corporation
> 50 Old Webster Road
> Oxford, MA 01540
> Attn: Product Returns
> Tel: 508-373-1100

* International Returns must include applicable DUTIES AND TAXES. You must mark air bills with “US GOODS, RETURNED FOR REPAIR”

C.2 Returns to Germany

1. IPG Laser GmbH will only accept returns for which an approved Return Material Authorization (RMA) has been issued by IPG Laser GmbH. You should address to the customer support team at +49-(0)2736-44-20-451 or support.europe@ipgphotonics.com to discuss the return and request an RMA number. You must return defective products freight prepaid and insured to IPG Laser at the address shown herein. All products which have returned to IPG Laser but which are found to meet all previously applicable specifications for such products or which indicate damage to the fiber connectors not resulting from defect manufacturing, shall be subject to IPG Laser' standard examination charge in effect at the time and these costs shall be charged to the Buyer. All products returned to IPG Laser which are not accompanied by an itemized statement of defects, shall be returned to the Buyer at the Buyer's expense and IPG Laser shall not carry out any evaluation of such products. IPG Laser warrants to Buyer that its services, labor and replacement parts, assemblies and modules will be free of defects in material and workmanship for ninety (90) days from the date of shipment or performance of services.
2. Warranty Returns - Domestic & *International Buyers should pay for one-way freight costs to IPG Laser. IPG Laser will reimburse Buyers for applicable reasonable third-party freight costs and IPG Laser will pay for freight return cost back to the Buyer.
3. Non-Warranty Returns - Domestic & *International Buyers are responsible for two-way freight costs. If shipment consists of returns that are both warranty and non-warranty, the shipment will be considered as non-warranty. Any UNAUTHORIZED shipments billed to IPG Laser without authorization will be re-invoiced to the Buyer. Confirming purchase orders are required for non-warranty returns.
4. *International Returns must include applicable DUTIES AND TAXES, and you must mark air bills with “RETURNED FOR REPAIR”. In any event, where IPG Laser accepts a shipment, IPG Laser will invoice to the Buyer for any charges as stated above.
5. Returns for credit will not be accepted unless authorized in advance, in writing by IPG Laser, in accordance with IPG Laser' Terms and Condition, including the warranty provisions. In most cases, restocking fees will apply.
6. All returns must be packaged adequately to avoid damage during shipment.
7. Complete packing list with product model and serial number will insure prompt repair, if the other terms of this form are followed.
8. See the IPG Terms and Conditions for the applicable warranty for the products before you request the return of the products.
9. RMA number will expire 31 days after the date of issue. Thereafter, units received in under the expired RMA number will result in a longer turnaround time. Include a copy of the completed RMA form with the return of your unit(s).

C.2.1 Shipping Instructions:

Shipping address for returns to Germany:

> IPG Laser GmbH
> Siemensstrasse 7
> D-57299 Burbach, Germany
> Attn: Product Returns
> Tel: +49-(0)2736-44-20-451