Scanner Series User Guide

MID-POWER AND HIGH-POWER SCANNERS

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1 Overview

1.1 Introduction

The IPG remote processing heads are powerful and flexible tools for applications that 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 electronic and mechanical hardware, and 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 scanner, 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

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 Lasers, refer to the following documentation (depending on the series 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 Software User Guide (DOCOXUGGUIXX0001)

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

- External Interface Board User Guide (DOCOXUGSCNXX0002)
- 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 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. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and does emit radio frequency energy, and if not installed and used in accordance with this guide, 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.

NOTE: The 3D scanners described in this user guide comply with part 18 of the FCC rules.

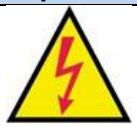
1.7 Safety Information and Conventions

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.
IMPORTANT	Text marked with Important refers to pertinent information regarding the operation of the product. Ensure you do not overlook this information.

1.7.1 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.

Modification of the product(s) could result in non-compliance with FCC rules.

1.7.2 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.

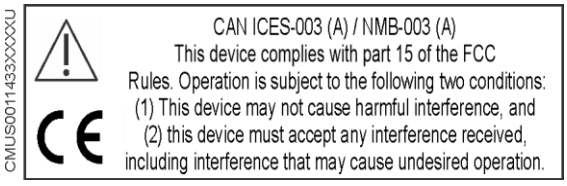
WARNING: The red guide laser can be installed in the connected laser product. It can emit up to 1mW average power near 660 nm wavelength and is classified as Class 2M visible laser radiation in terms of IEC 60825-1. Avoid direct eye exposure.

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

1.7.3 Safety Labels

Table 1-2 lists the safety labels included on the IPG Scanners and Scan Controllers.

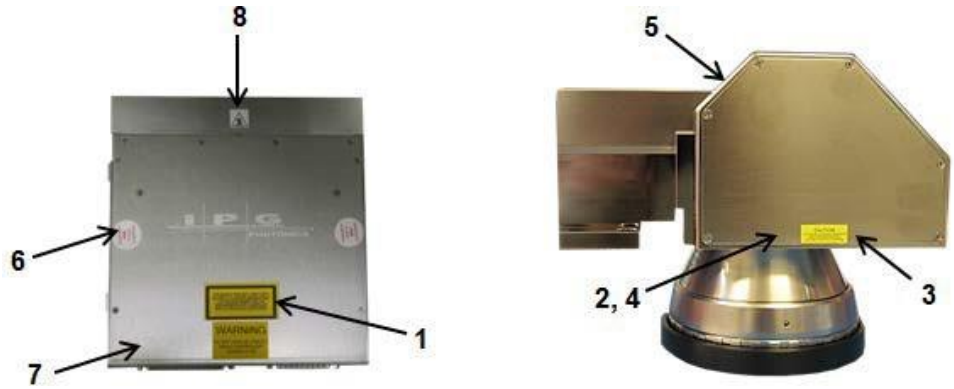
Table 1-2 Safety Labels

Label Name	Description	Label Name	Description
Component Label		Identification Label	
Laser Radiation Hazard Label		Warranty Void Sticker	
Class 4 Laser Product		Functional Earth Label	
Aperture Label		Hot Surface Label	
CE Label Note: This label ONLY appears on the product if the product is CE-certified.			

1.7.4 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

1.8 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.

CAUTION

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.8.1 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.

1.8.2 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.

1.8.3 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.

WARNING: The input voltage to the laser is potentially lethal. All electrical cables and connections should be treated as if it were a harmful level. All parts of the electrical cable, connector, or device housing should be considered dangerous.

1.8.4 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.

The equipment is designed for: 1) indoor use, 2) operation at less than 2000 meters altitude, 3) Over Voltage Category I, 4) a Pollution Degree 2 environment, and 5) dry locations. Refer to product specifications for additional information.

This equipment is not suitable for use in wet locations, or where children are likely to be present. Keep this equipment away from sources of shock or vibration.

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.

1.9 Safety Features

1.9.1 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.

1.10 Additional Safety Resources

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

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

American National Standards Institute
ANSI Z136.1: American National Standard for the Safe Use of Lasers
(Available through LIA)

International Electrotechnical Commission
IEC 60825-1
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 U.S.

US Department of Labor - OSHA
1910 Subpart I – Personal Protective Equipment

- 1910.132, General Requirements
- 1910.133, Eye and face protection

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.

1.11 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.

1.11.1 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.

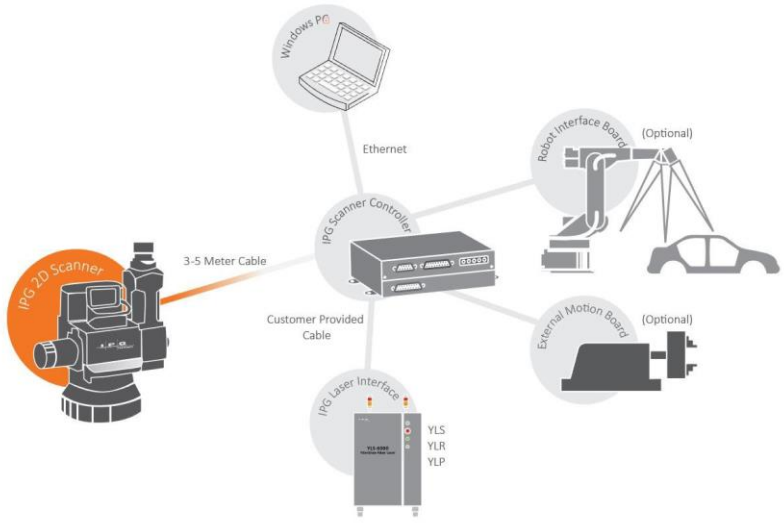
2 System Architecture

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

2.1 Scanners with an IPG Scan Controller

Figure 2-1 details the basic system architecture when using an IPG Scan Controller. The basic system is composed of the following components:

Figure 2-1 IPG Scan Controller Architecture



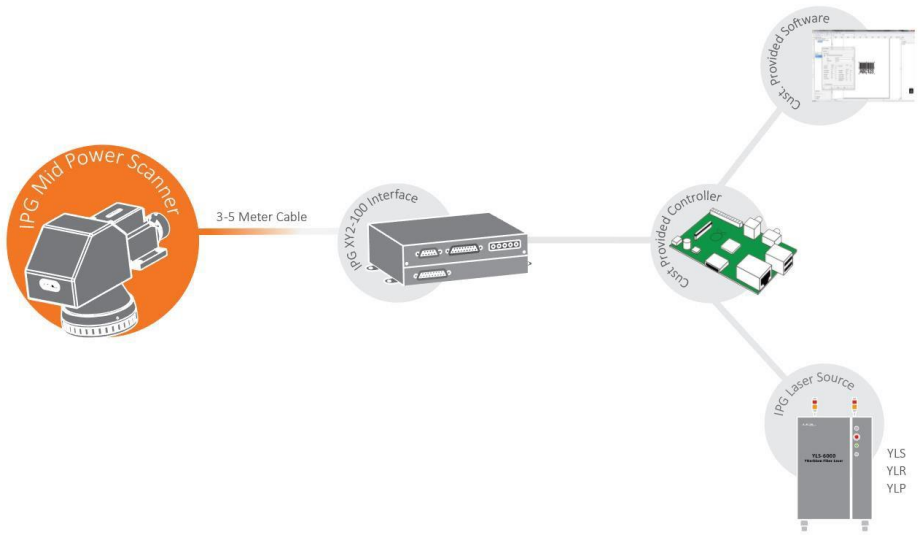
- Scan Head:
  - Houses the galvo mirrors and beam shaping optics (collimator, field flattening lenses, etc.)
- Scan Controller:
  - Houses all electronics, including controller board, galvo driver boards, etc.
  - Available for Mid-Power and High-Power Scanners
- Windows PC & Windows PC software:
  - 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 Scanners with an XY2-100 Interface (Mid-Power Scanner 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



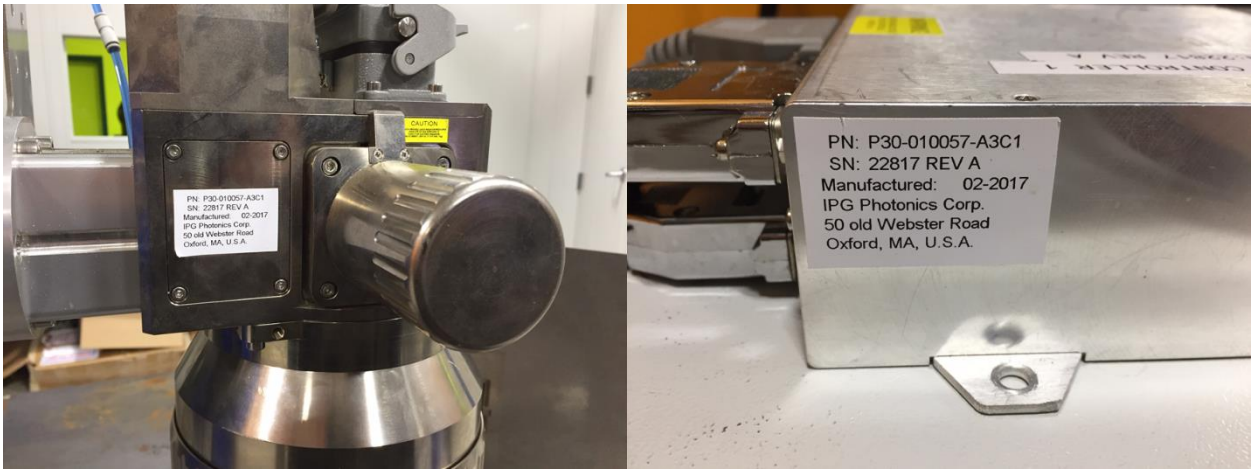
- Scan Head:
  - Houses the galvo mirrors and beam shaping optics (collimator, field flattening lenses, etc.)
- Scanner XY2-100 interface:
  - Houses all electronics, including controller board, galvo driver boards, etc.
  - Only applicable for Mid-Power Scanners.
- Customer Provided controller:
  - 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

Product part numbers and serial numbers are located on a white sticker on the scan head and on the Scan Controller. Figure 2-3 outlines the product label on both a scan head and Scan Controller.

IMPORTANT **Scan heads and Scan Controllers are tuned as a single pair. This means that a scan head should only be used with the Scan Controller that it is paired with. Using a scan head with a Scan Controller that have not been tuned may result in damage to the scan head.**

Figure 2-3 Scanner and Scan Controller Labels



Note Old part number conventions may use a P30-Series number. If users cannot determine their product configuration using the configurations provided below, please contact an IPG Sales Representative or Product Specialist.

2.3.1 Mid-Power Scanner Part Number Configurations

Figure 2-4 and Figure 2-5 outline the available configurations for the Mid-Power Scanner.

Figure 2-4 Mid-Power Scanner with Bayonet Input Part Number Configurations

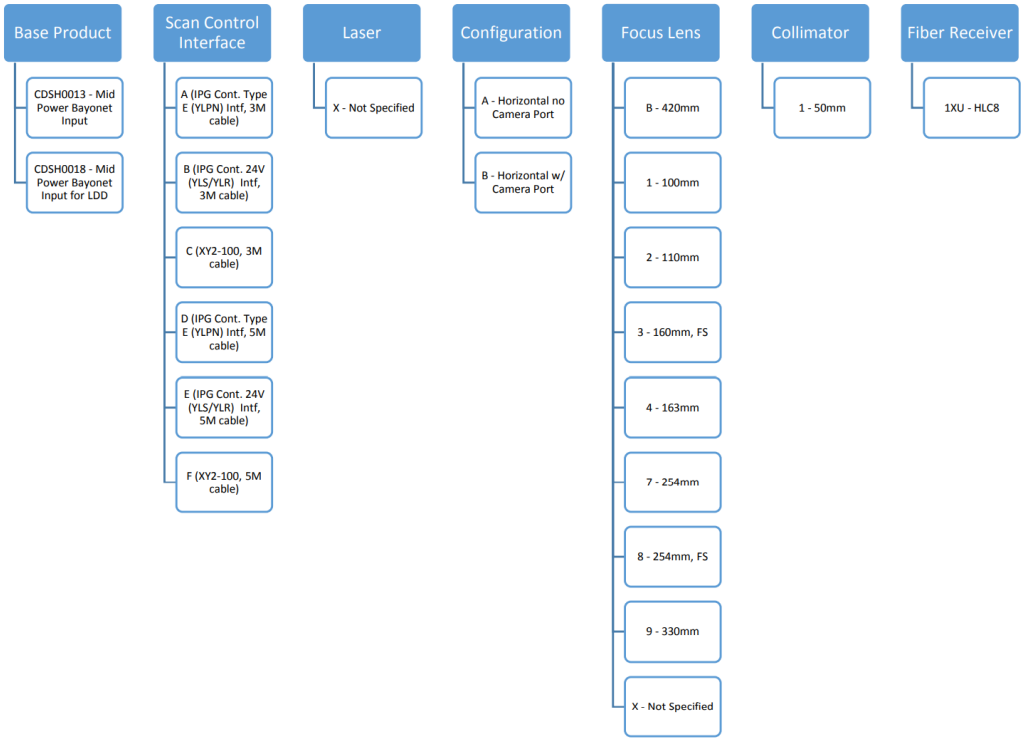
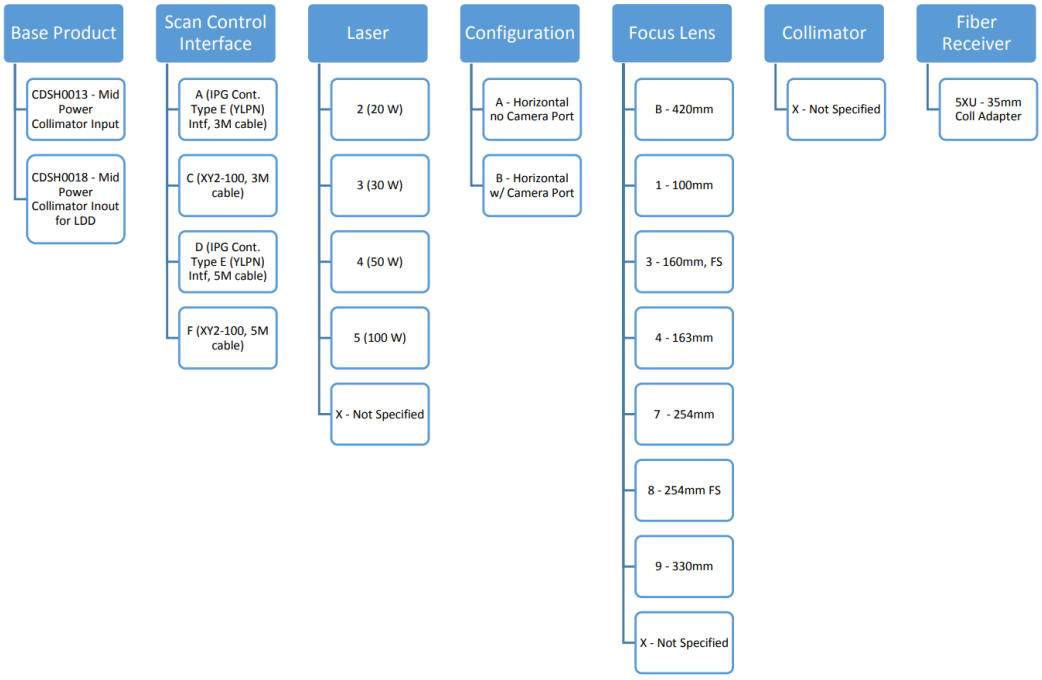


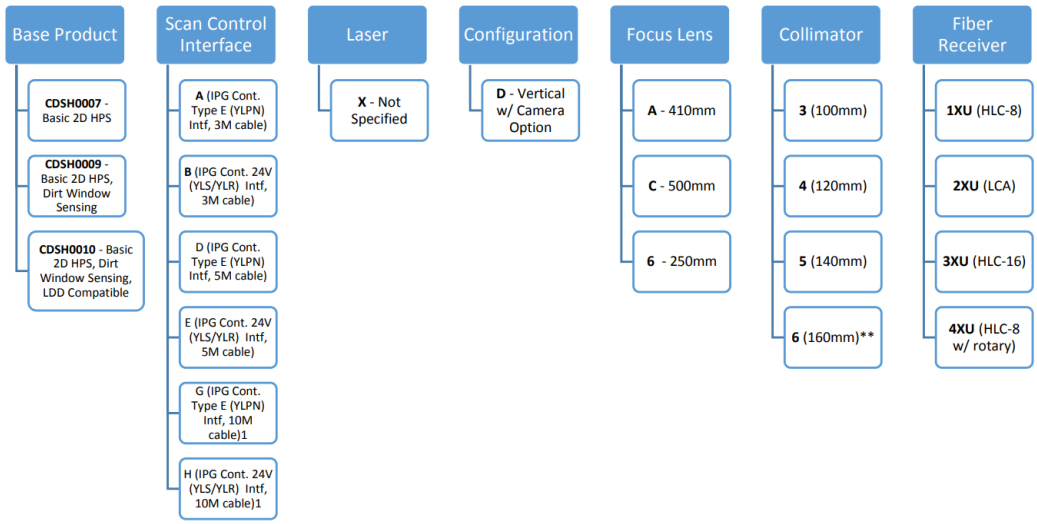
Figure 2-5 Mid-Power Scanner with Collimator Input Part Number Configurations



2.3.2 2D High-Power Scanner Part Number Configurations

Figure 2-6 outlines the available configurations for the 2D High-Power Scanner.

Figure 2-6 2D High-Power Scanner Configurations



3 Product Specifications

The following sections outline the specifications for each scanner.

3.1 Mid-Power Scanner

Table 3-1 Mid-Power Scanner Specifications

Optical Specifications					
Wavelength (nm)	1030 – 1080				
Clear Aperture (mm)	12				
Available Fiber Adapters	HLC-8 or 35mm Collimator Input				
Collimator Length – HLC-8 Only (mm)	50				
Low Power Lens Specifications					
Maximum Multimode Power (kW)	.200				
Maximum Single Mode Power (kW)	.200				
Focal Length Options (mm)	100	163	254	330	420
Field Size ([X]mm x [Y]mm)	60 x 60	110 x 110	170 x 170	204 x 204	300 x 300
Nominal Working Distance (mm) +/-5%	102	186	285	390	493
Fused Silica (Multimode) Lens Specifications*					
Maximum Multimode Power (kW)	2				
Focal Length Options (mm)	163		254		
Field Size ([X]mm x [Y]mm)	80 x 80		160 x 160		
Nominal Working Distance (mm) +/-5%	136		244		
Fused Silica Lens Specifications**					
Maximum Multimode Power (kW)	2				
Maximum Single Mode Power (kW)	.5				
Focal Length Options (mm)	100	163	254	420	
Field Size ([X]mm x [Y]mm)	50 x 50	102 x 102	175 x 175	280 x 280	
Nominal Working Distance (mm) +/-5%	125	204	304	512	
Dynamic Performance					
Tracking Delay (µs)	100				
Repeatability [rms] (µrad)	< 5				
Available Control Schemes	IPG Scan Controller or XY2-100 Interface				
Approximate Weight – Head Only (kg)	4-6 (configuration dependent)				

*Not Optimized for single mode lasers.

** Not available in scanner configuration. Scanner must be ordered without lens and lens must be ordered separately.

3.2 2D High-Power Scanner

Table 3-2 High Power Scanner Specifications

Optical Specifications				
Wavelength (nm)	1030 – 1080			
Clear Aperture (mm)	33			
Available Fiber Adapters	HLC-8, HLC-8 with Rotary, LCA, or HLC-16			
Maximum CW Power Handling (kW)	12			
Maximum Single Mode Power Handling (kW)	2			
Collimator Specifications				
Collimator Focal Length Options (mm)	100	120	140	160
Maximum Multimode Power (kW)	12	12	12	2
Maximum Single Mode Power (kW)	2	2	2	2
Focus Lens Specifications				
Focal Length Options (mm)	250	400	500	
Nominal Working Distance (mm) +/-5%	261	415	526	
Field Size ([X]mm x [Y]mm)	110 x 110	200 x 200	250 x 250	
Angle of Incidence at X Edge of FOV	±4.13˚	±8.25˚	±9.18˚	
Angle of Incidence at Y Edge of FOV	±6.42˚	±9.79˚	±10.34˚	
Beam Divergence Full Angle	7.4˚	4.58˚	±2.52˚	
Dynamic Performance				
Tracking Delay (µs)	500			
Repeatability [rms] (µrad)	< 5			
Available Control Schemes	IPG Scan Controller			
Approximate Weight –Head Only (kg)	11.3-14.0 (configuration dependent)			

3.3 3D High Power Scanner

Table 3-3 3D High Power Scanner Specifications

Optical Specifications	
Wavelength (nm)	1030 – 1080
Available Fiber Adapters	HLC-8, HLC-8 with Rotary, LCA, or HLC-16
Maximum Power Handling (kW)	10
Magnification	3.6x
Field of View Size ([X]mm x [Y]mm x [Z]mm)	300 x 300 x 100
Nominal Working Distance (mm)	470
Dynamic Performance	
Tracking Delay (µs)	1000
Repeatability [rms] (µrad)	< 5
Available Control Schemes	IPG Scan Controller
Approximate Weight – Head Only (kg)	15.8-18.2 (configuration dependent)

3.4 Scanner Water Cooling Specifications

The following sections outline water-cooling specifications for Mid-Power (Bayonet Input version) and High-Power scanners.

3.4.1 Temperature, Humidity, and Water Cooling Specifications

Table 3-4 details temperature, humidity, and water-cooling specifications for both the Mid-Power (Bayonet Input version) and High-Power Scanners.

Table 3-4 Temperature, Humidity, and Water Cooling Specifications

Water Cooling Requirement	
Mid-Power Scanner	Power levels greater than .5kW
2D High-Power Scanner	Power levels greater than 1kW
3D High Power Scanner	Power levels greater than 1kW
Temperature & Humidity	
Operating Temperature Range (^{o}C)	10-40
Humidity	10-90% RH non-condensing
Water Cooling Specifications	
DI or Tap Water Temperature (^{o}C)	25-30
Flow Rate Minimum (l/min)	0.75
Fittings	6mm OD x 4mm ID Tubing or 1/4in Equivalent

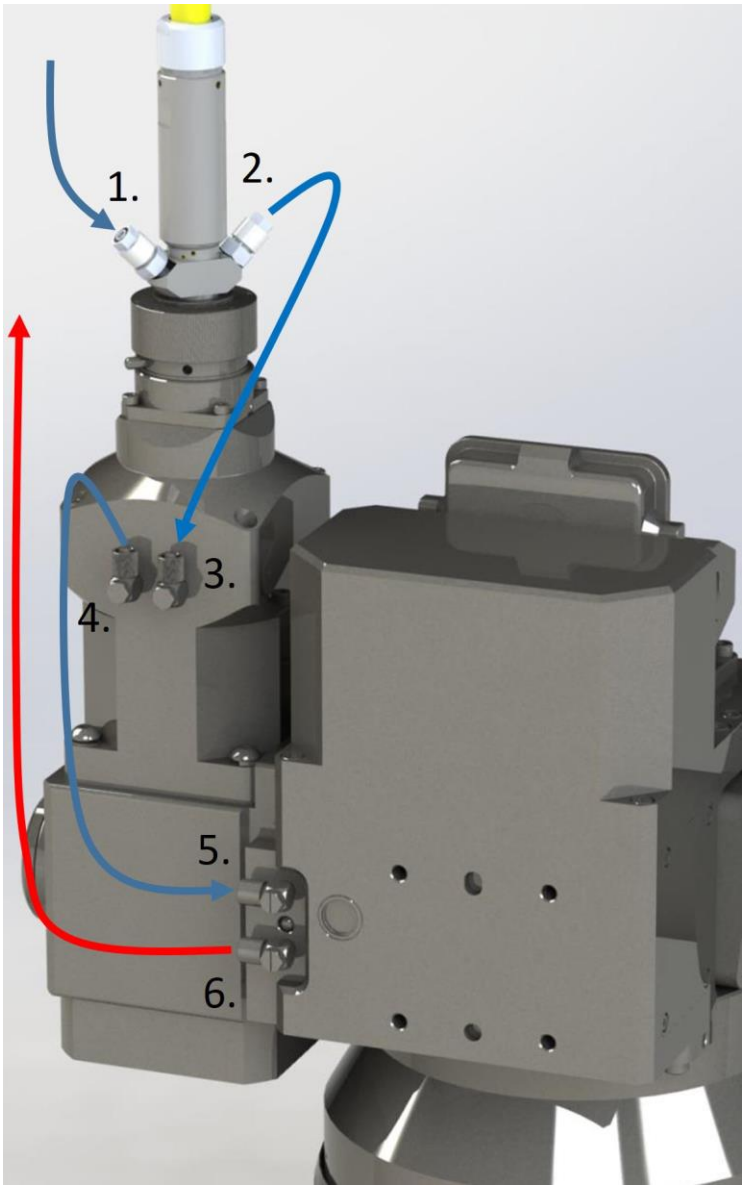
3.4.2 Water Connection Overview

In order to best achieve the minimum flow rates, it is recommended to make all water-cooling connections in-series. The following sequence outlines the typical water cooling connection to the head.

1. Water inlet to the fiber
2. Water outlet from the fiber
3. Water inlet to the collimator
4. Water outlet from the collimator
5. Water inlet to the scanner body
6. Water outlet from the scanner body and return to the laser or chiller

Figure 3-1 outlines a typical in-series water connection to the scanner. Although a 2D High-Power scanner is pictured, the same principle applies to the Mid-Power scanner (Water Cooling Supply → Fiber → Collimator → Water Cooling Return). Please note that water flow is not limited to a specific direction through the fiber, collimator, or scanner body.

Figure 3-1 In-Series Water Connections to a 2D High-Power Scanner



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)
		^oC	^oF	
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, a ½-inch ID hose is required as the final connection for a 9-inch knife fed by a ¾-inch ID to the compressor. A 9-inch air knife requires approximately 30CFM at 100psi.

Please refer to accompanying air knife documentation for additional details.

3.6 Computer Specifications (For use with IPG Scan Controllers)

In order to operate any IPG Scanner with a Scan Controller, a computer must be connected and running IPGScan at all times.

Table 3-6 details minimum computer specifications that must be met for use with IPGScan software.

Table 3-6 Computer Specifications

Operating System	Windows 10, Professional or Enterprise | 64-bit
CPU	- 6 cores - 3.60 GHz Operating Frequency - CPUmark (23323 MT / 2256 ST)
RAM	- 32 GB DDR4-2400 ECC
Hard Drive	- 250 GB SSD
Connections	- Ethernet Ports o One is required for connecting to the Scan Controller o (Robotic OTF Processing Only) One for robot communications o (Optional) One for Remote API (TCP/IP) functionality with IPGScan o (Optional) One for connecting to laser software (i.e. LaserNet) o (Optional) One for an Ethernet camera

While IPG does not supply a computer with the purchase of a scanner, the computer that is supplied with the purchase of an LDD system is capable of running IPGScan. Please refer to the appropriate LDD documentation or consult with an LDD Product Specialist for details concerning the LDD computers.

4 Mechanical Connections and Drawings

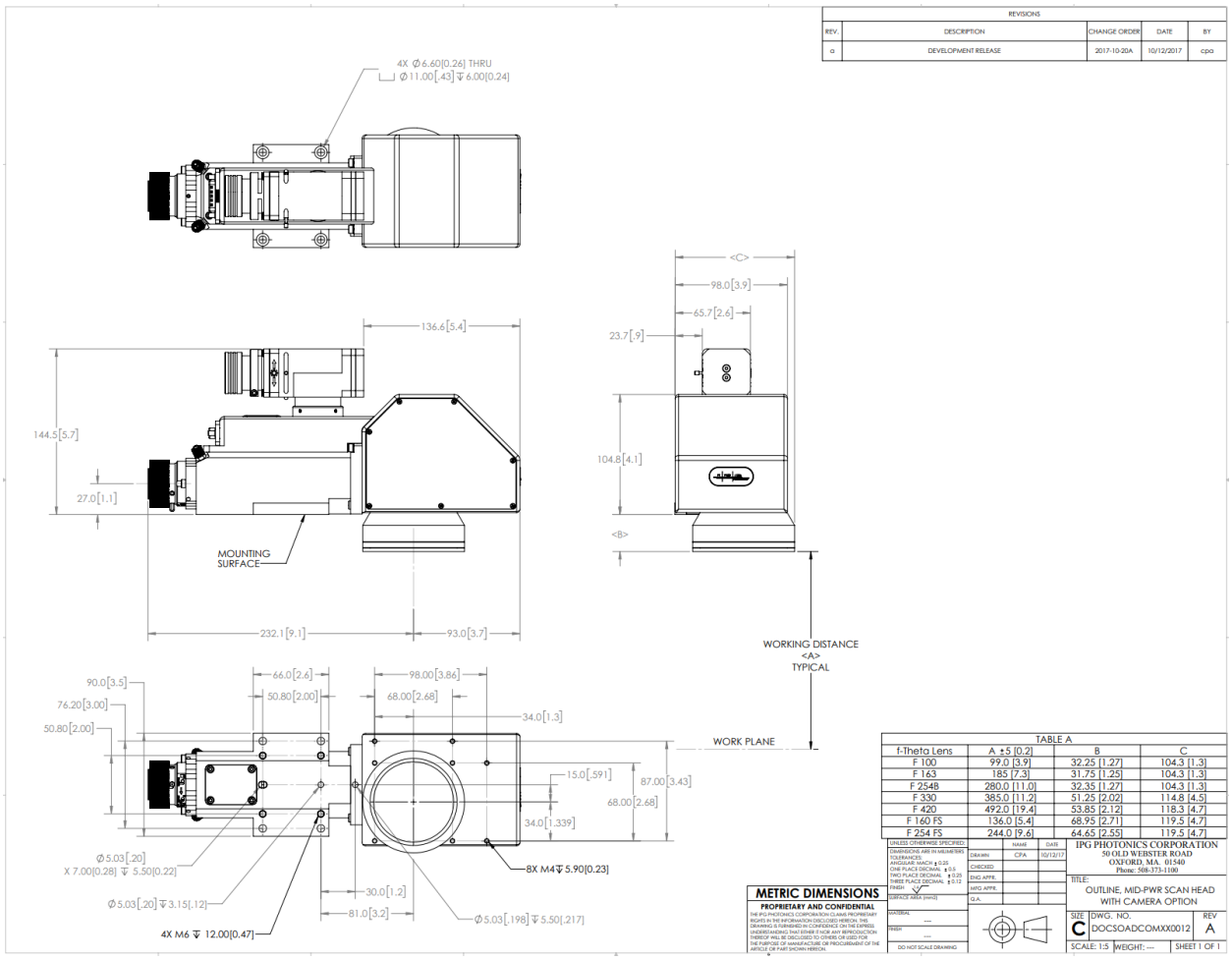
The following sections outline the mechanical dimensions and connections for each specific product.

4.1 Mid-Power Scanner

4.1.1 Mid-Power Scanner with Bayonet Input

Please refer to Figure 4-1 for mechanical dimensions and working distances of Mid-Power Scanners with Bayonet Input.

Figure 4-1 Mid-Power Scanner with Bayonet Input Mechanical Drawing

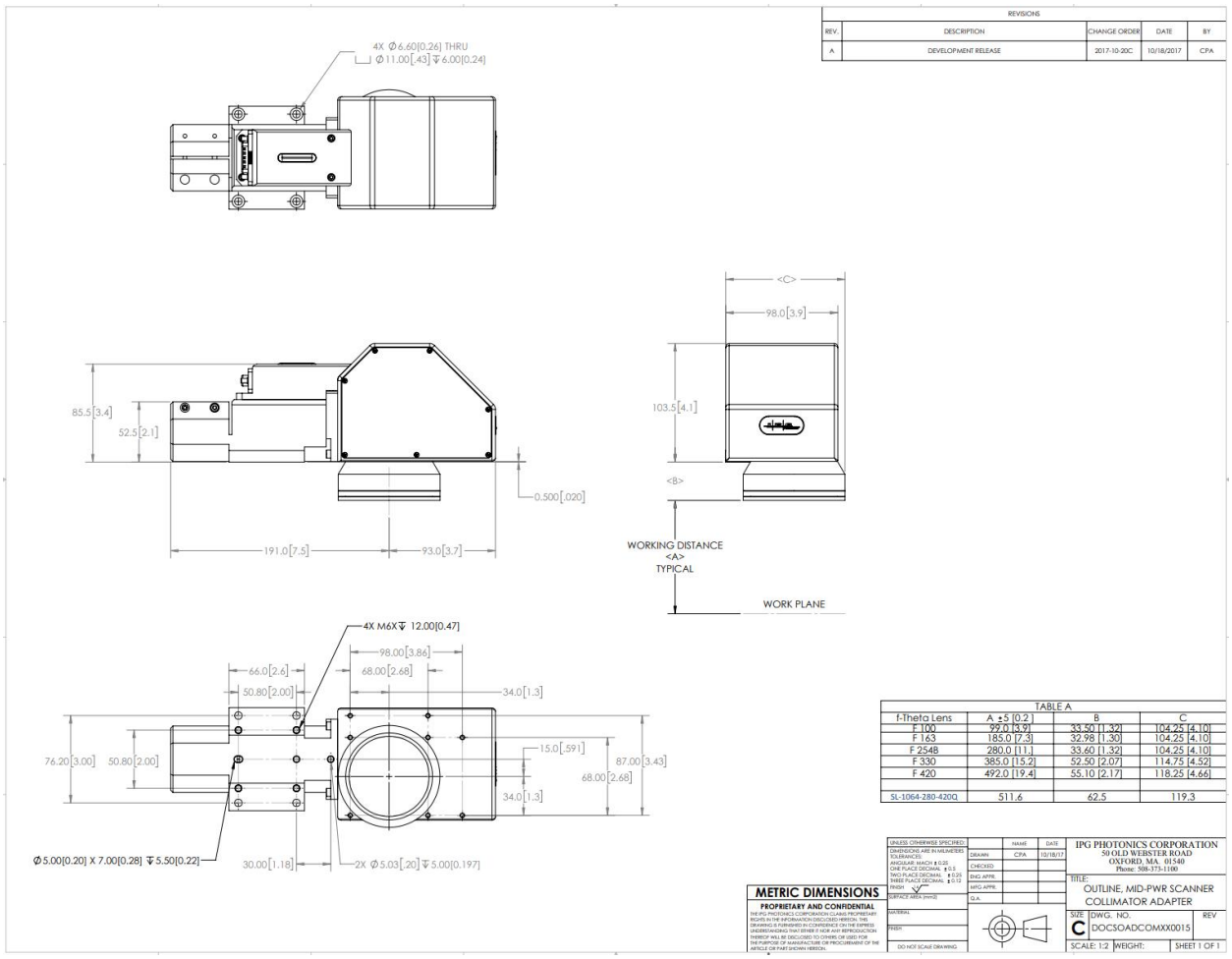


IMPORTANT Camera arm purchased separately from the scanner.

4.1.2 Mid-Power Scanner with Collimator Input

Please refer to Figure 4-2 for mechanical dimensions of the Mid-Power Scanner with Collimator Input.

Figure 4-2 Mid-Power Scanner with Collimator Input Mechanical Drawing

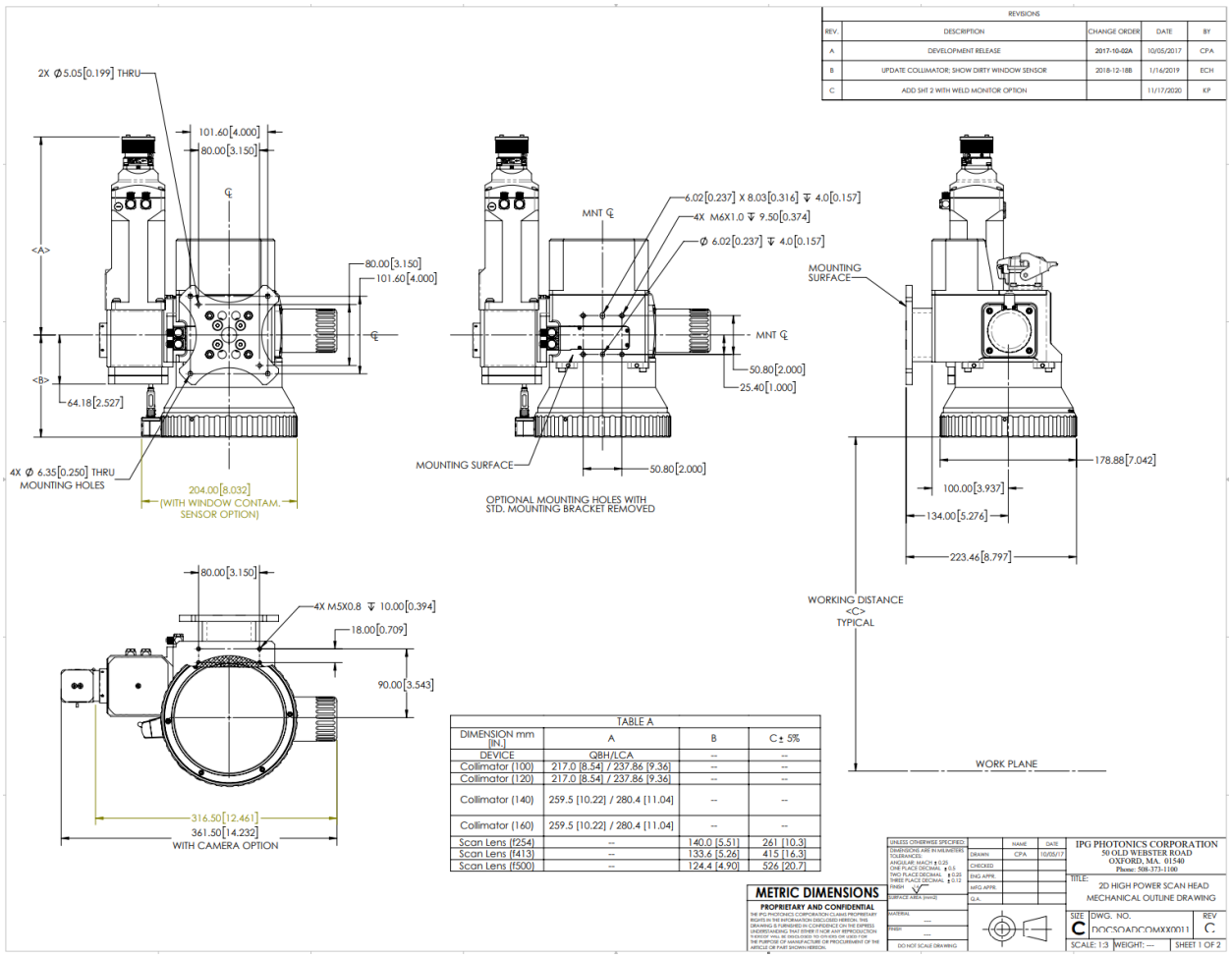


4.2 2D High-Power Scanner

4.2.1 Mechanical Drawings

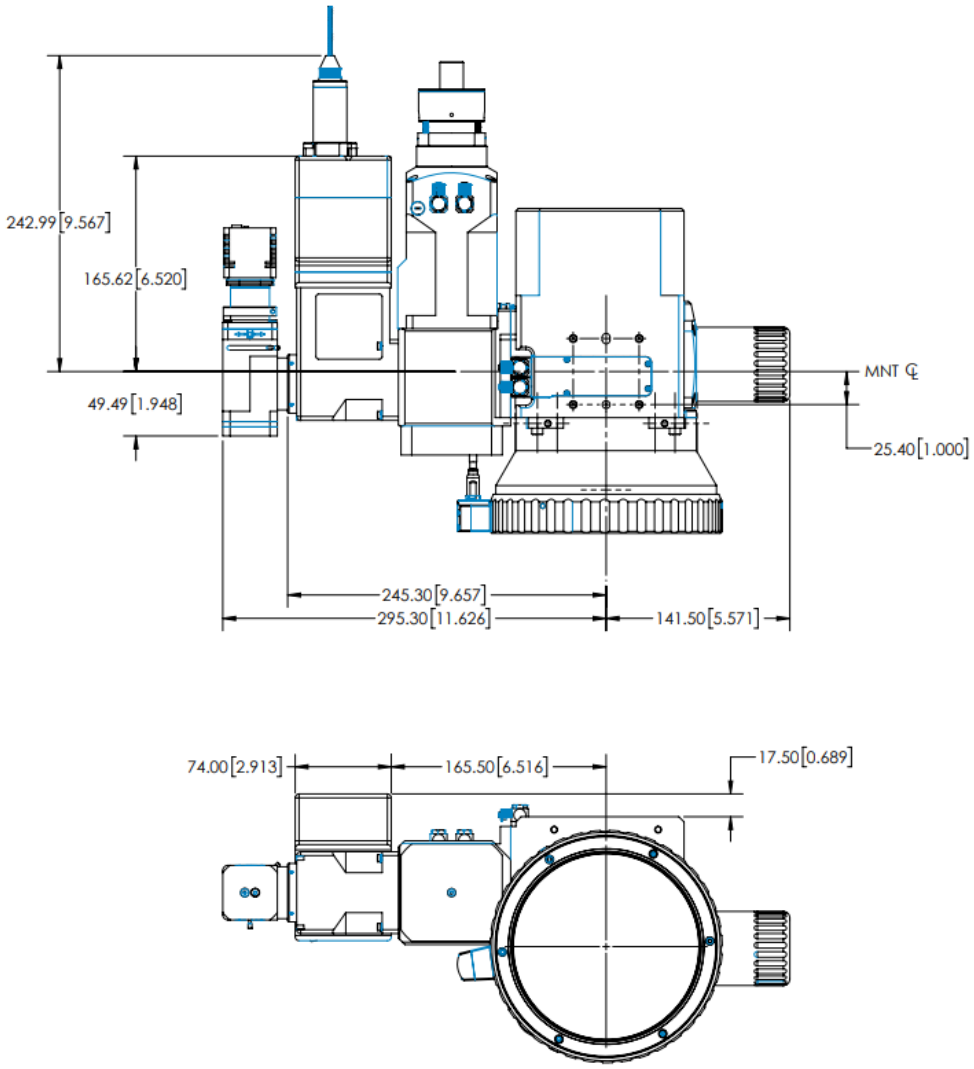
Please see Figure 4-3 and Figure 4-4 for 2D High-Power Scanner dimensions.

Figure 4-3 2D High-Power Scanner Mechanical Drawing



IMPORTANT Camera arm purchased separately from the scanner.

Figure 4-4 2D High-Power Scanner with LDD and Camera Mechanical Drawing



IMPORTANT LDD and camera arm purchased separately from the scanner.

4.2.2 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.

For mass properties specific to the users application, please provide product configuration details along with any accessories to an IPG Product Specialist for more detailed results.

Table 4-1 2D High-Power Scanner Mass Properties without Accessories

2D High-Power Scanner Mass Properties without Accessories			
Mass (kg)	11.5		
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

For mass properties specific to the user's application, please provide product configuration details along with any accessories to an IPG Product Specialist for more detailed results.

4.2.3 Mounting Specification

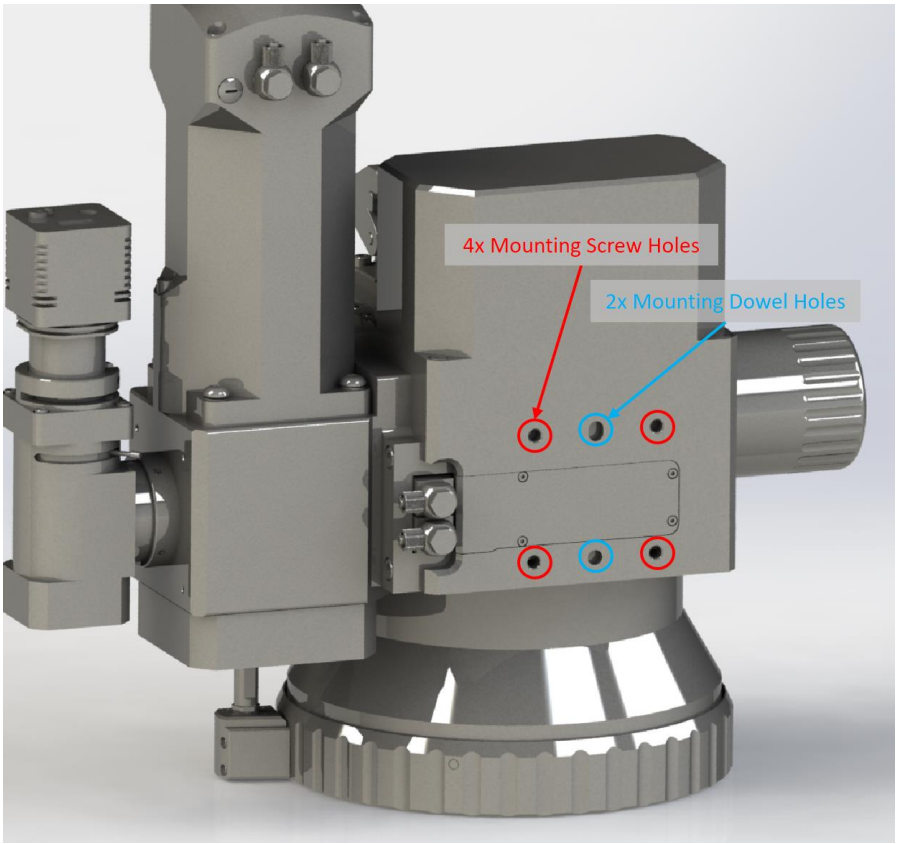
When mounting the scanner without the standard mounting bracket, the specifications outlined in Table 4-2 apply.

Table 4-2 2D High-Power Scanner Mounting Specification (No Standard Mount Bracket)

M6 Screw Specification	
Thread Engagement (mm)	6 – 9 (Prefer high end for greatest strength)
Torque (in*lbs)	50 – 100 (No lubrication. Prefer high end of torque spec for robotic applications)
Additional Recommendations	Lock washers recommended. No Loctite.
M6 Dowel Specification	
Diameter (mm)	6 +.004/+.012
Dowel Engagement (mm)	3 – 5

Figure 4-5 outlines the mounting screw and dowel hole locations on the back of the 2D High Power Scanner.

Figure 4-5 2D High-Power Scanner Mounting Holes

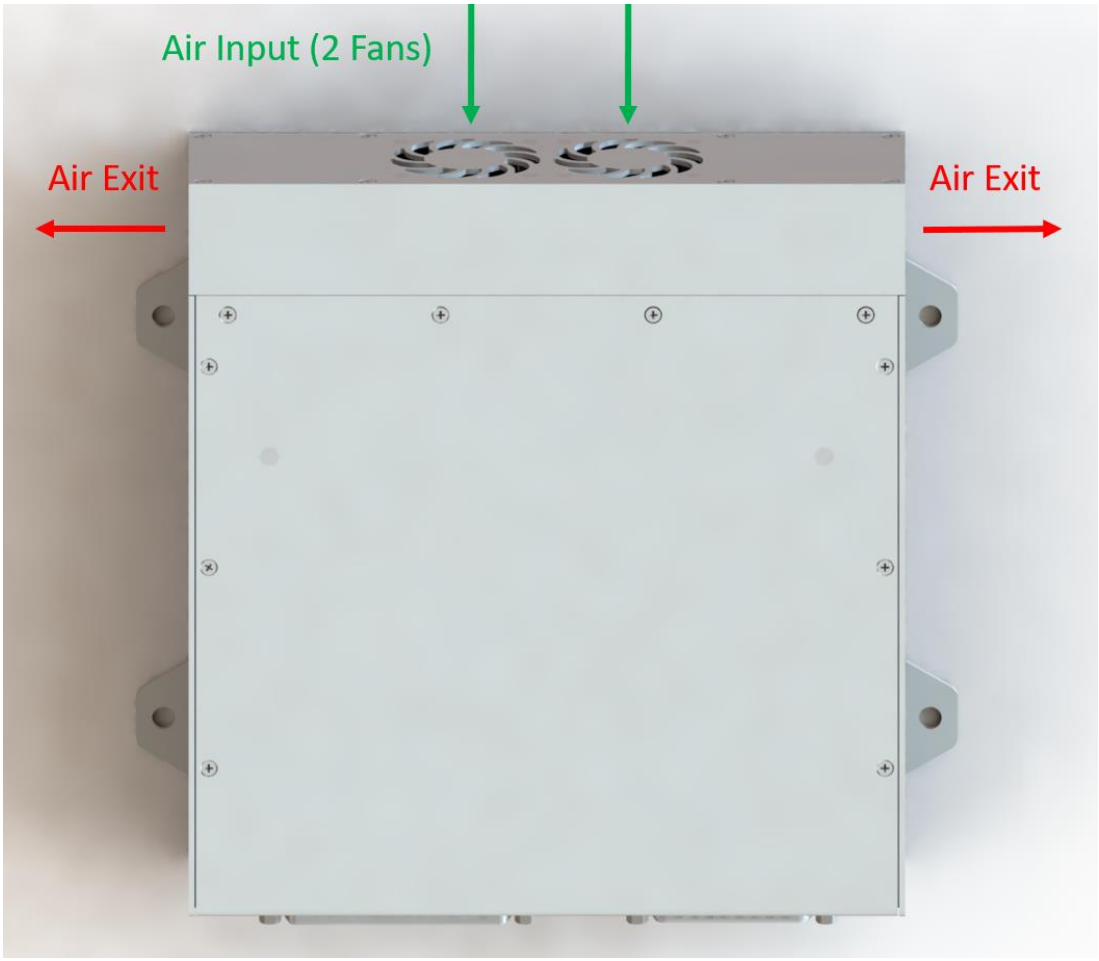


4.3 IPG Scan Controller

4.3.1 Fans and Cooling

Figure 4-6 outlines the fan location on the Scan Controller.

Figure 4-6 Scan Controller Fans

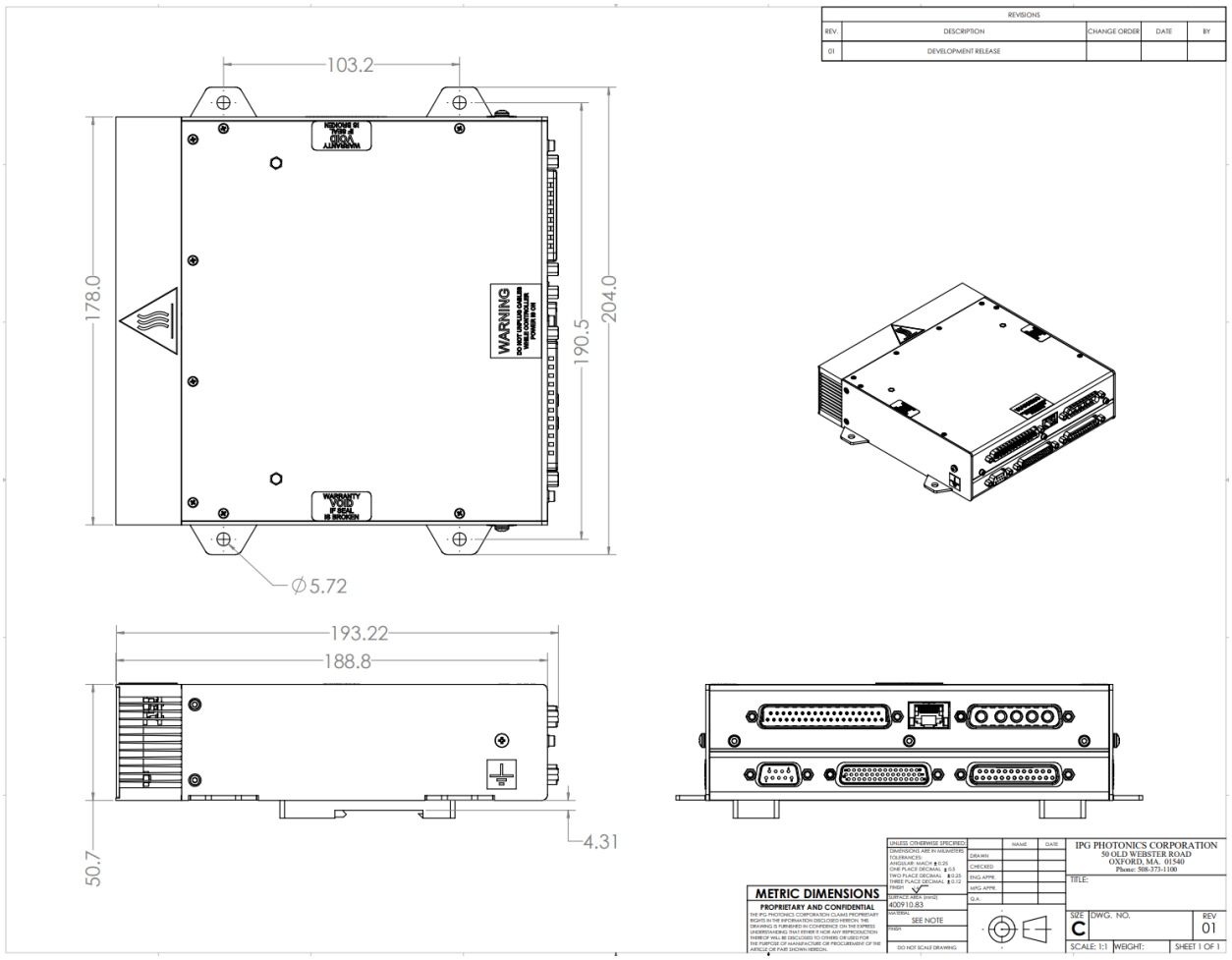


CAUTION	
	THE SURFACE OF THE CONTROLLER CAN BE HOT, PARTICULARLY IN HIGH AMBIENT TEMPERATURES! LEAVE sufficient CLEARANCE for AIR INPUT (FANS) and AIR EXITS.
	IPG recommends a minimum of 12mm under normal conditions. High ambient temperature or continuous operation may require additional clearance.

4.3.2 Mid-Power and 2D High-Power Scanners

Figure 4-7 provides the dimensions of a Scan Controller for both Mid-Power and 2D High Power Scanners. XY2-100 Interfaces have the same mechanical dimensions but differing electrical connectors.

Figure 4-7 Scan Controller Mechanical Drawing



4.3.2.1 Mid-Power and 2D High-Power Scan Controller Mounting Options

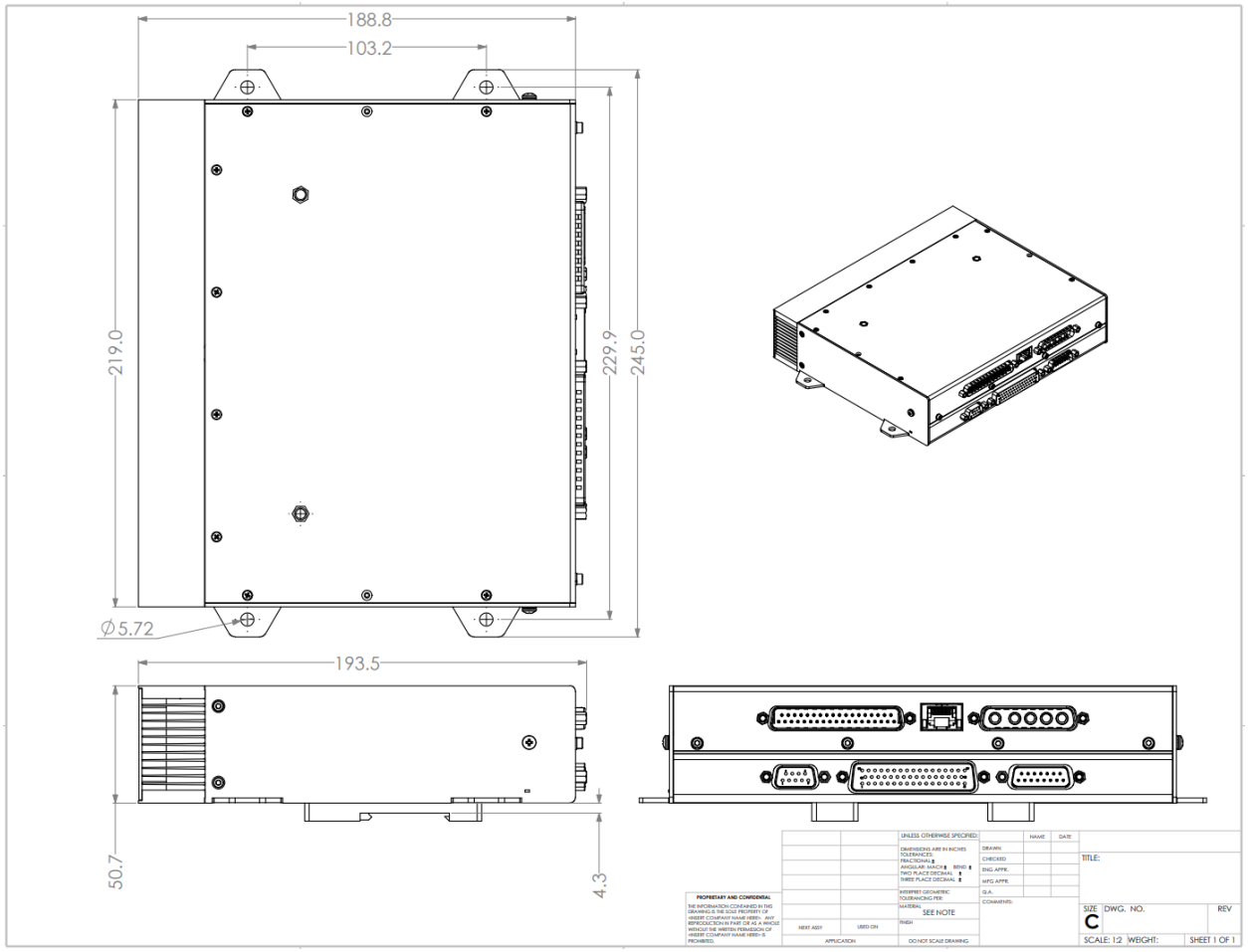
The Mid-Power and 2D High-Power Scan Controller mounting options include the following:

- Two (2) removable DIN Rail Mounts with T35 clips
- Four (4) fixed mounting tabs (remove DIN Rail Mounts)

4.3.3 3D High-Power Scanner

Figure 4-8 provides the dimensions of a Scan Controller for the 3D High Power Scanner.

Figure 4-8 3D High-Power Scan Controller Mechanical Drawing



4.3.3.1 3D High-Power Scan Controller Mounting Options

The 3D High-Power Scan Controller mounting options include the following:

- Two (2) removable DIN Rail Mounts with T35 clips
- Four (4) fixed mounting tabs (remove DIN Rail Mounts)

4.4 Fiber Connection

4.4.1 Overview

The scan heads use IPG Process collimators that are factory aligned and water-cooled for optical & thermal stability. Collimators are equipped with FCH-8/HLC-8, HLC-16 (sometimes referred to as QBH), or LCA/QD type fiber receivers which are **only** compatible with the corresponding fiber bayonets.

IMPORTANT **The following instructions are not applicable for the Mid-Power Scanner with Collimator Input.**

4.4.2 Fiber Installation (HLC and LCA Receivers)

The procedure for fiber installation entails the following:

1. Power off the scan head/Scan Controller.
2. Rotate the head so the collimator is angled down towards the ground.
    a. This is to help prevent debris from entering into the collimator.
3. Release the debris tray.
    a. Refer to section 4.4.3.1 for information concerning debris tray operation.
4. Perform a fiber inspection.
    a. Please refer to the lasers manual for specific information pertaining to fiber inspection and cleaning.
5. Insert the fiber into the fiber receiver.
    a. Refer to sections 4.4.3.2 or 4.4.3.3 for details concerning specific fiber receiver operation.
6. Connect water lines (if power levels require the use of water-cooling).
    a. Prior to rotating the head vertical, users should turn on the chiller and inspect water lines for any leaks.
7. Retract the debris tray.
8. The scanner can now be powered up and rotated into any desired position for use.

4.4.3 Fiber Removal (HLC and LCA Receivers)

The procedure for fiber removal entails the following:

1. Power off the scan head/Scan Controller.
2. Rotate the head so the collimator is angled down towards the ground.
    a. This is to help prevent debris from entering into the collimator.
3. Release the debris tray.
    a. Refer to section 4.4.3.1 for information concerning debris tray operation.
4. Disconnect water lines (if power levels require the use of water-cooling).

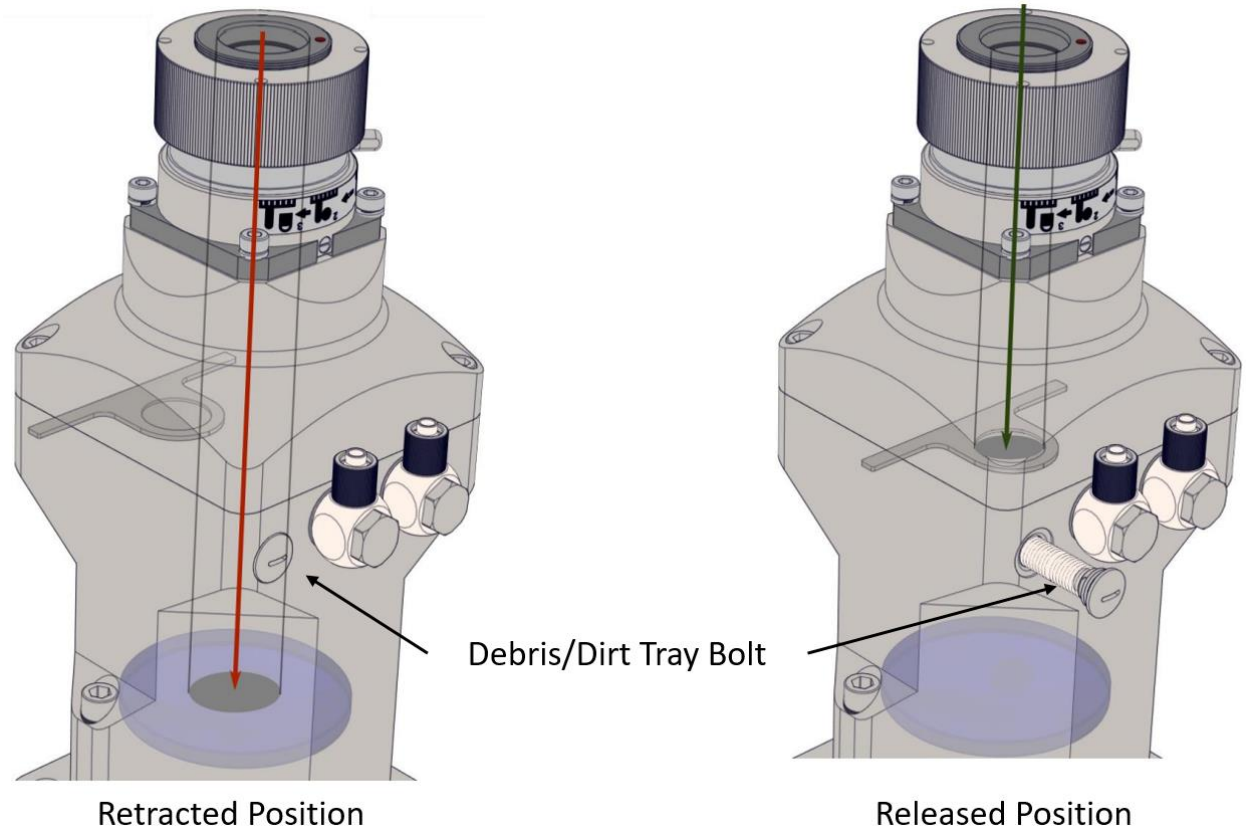
Be sure to power down the chiller and close any valves to reduce water leaking when disconnecting water lines.

5. Remove the fiber from the fiber receiver.
    a. Be sure to put a protective cover on the fiber and also put the protective plug into the collimator.
    b. Refer to sections 4.4.3.2 or 4.4.3.3 for details concerning specific fiber receiver operation.
6. Retract the debris tray.
7. If the head is to be removed from the machine for a period of time, drain all water lines.

4.4.3.1 Debris Tray Operation

The debris tray helps to prevent the introduction of contamination to the collimator during fiber installation and removal. Figure 4-9 details the debris tray in both the retracted and released positions.

Figure 4-9 Debris/Dirt Tray on the 2D High-Power Scanner



To release or retract the debris tray, simply turn the debris tray bolt accordingly.

- For Fiber Installation/Removal (Release): Turn the bolt anti-clockwise. The laser cannot be fired when the tray is released (a fiber interlock is broken).
- For Laser Operation (Retract): Push the bolt in and turn it clockwise until it is fully retracted.

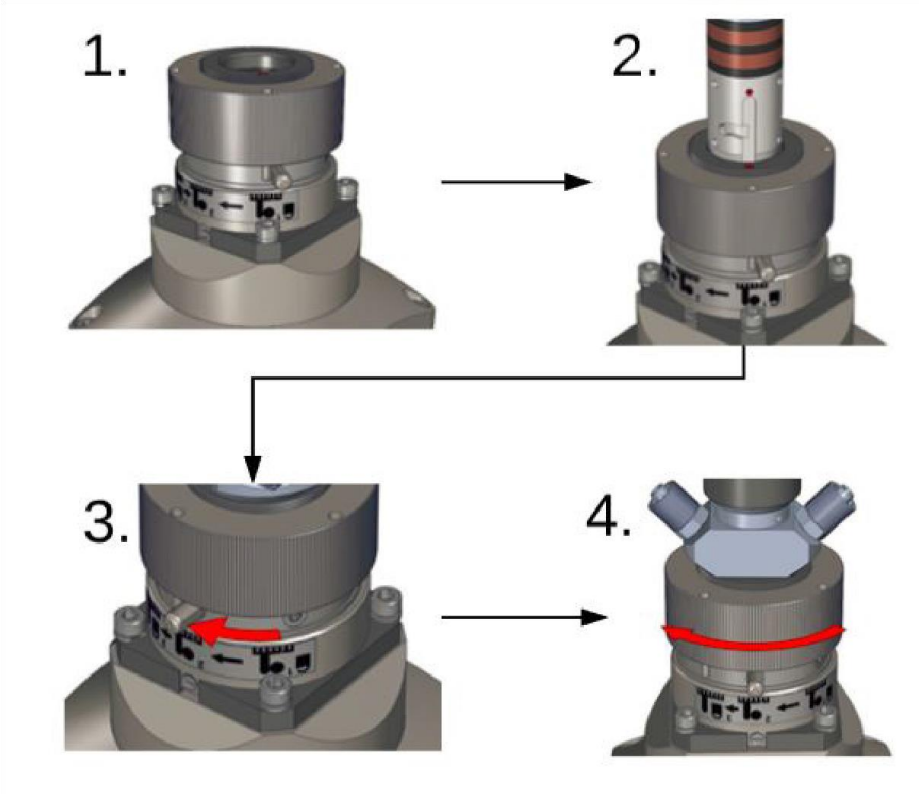
To minimize contamination of optics, install or remove the fiber with the head in a horizontal position.

4.4.3.2 HLC-8, HLC-16, or QBH Fiber Receivers

The following steps outline the procedure to connect a FCH-8/HLC-8 or HLC-16 fiber and receiver. See Figure 4-10.

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 4-10 HLC-8/QBH Fiber Receiver Connection



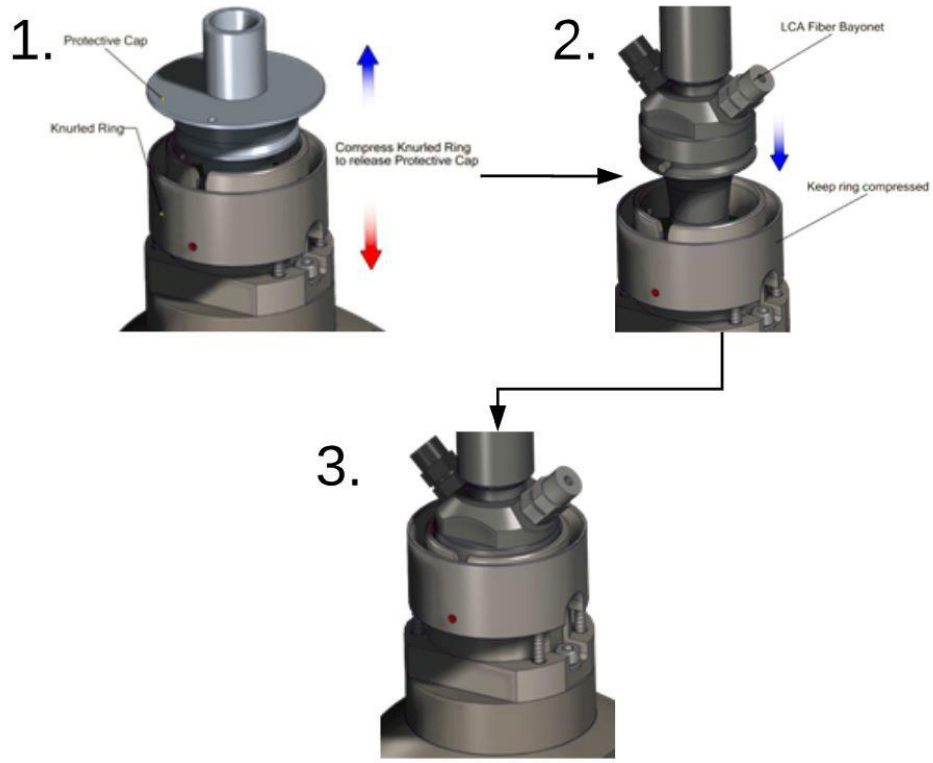
To remove the fiber, reverse the order of steps 1-4.

4.4.3.3 LCA/QD Fiber Receivers

The following steps outline the procedure to connect a LCA/QD fiber and receiver. See Figure 4-11.

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 4-11 LCA/QD Fiber Receiver Connection



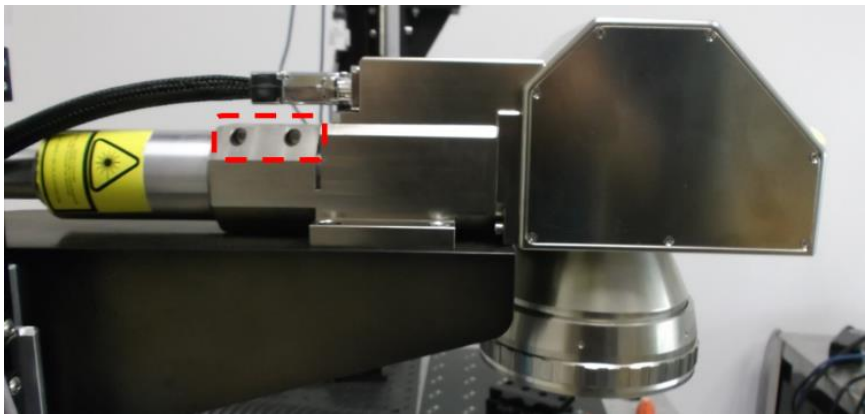
To remove the fiber, reverse the order of steps 1-3.

4.4.4 Installing Laser with Collimator to Mid-Power Scanner with Collimator Input

The 35mm collimator interface of the Scan Head enables easy installation with the standard 35mm collimator on your IPG IR pulsed laser to be used with the IR Scanner. Following the procedure below to install the collimator into the Scan Head:

1. Make sure both the scanner and the laser module box are placed on a stable surface.
2. Loosen the two screws on the collimator holder on the scanner (circled in red dashed lines above).

Figure 4-12 The Two Screws on the Collimator Holder



3. Remove the cap that covers the collimator, carefully insert the collimator into the collimator holder on the scanner, and gently push it all the way.
4. Tighten the two screws on the collimator holder to secure the installation.

5 Supplementary Equipment/Accessories

5.1 Air Knife Configurations and 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 Scanner Mounting

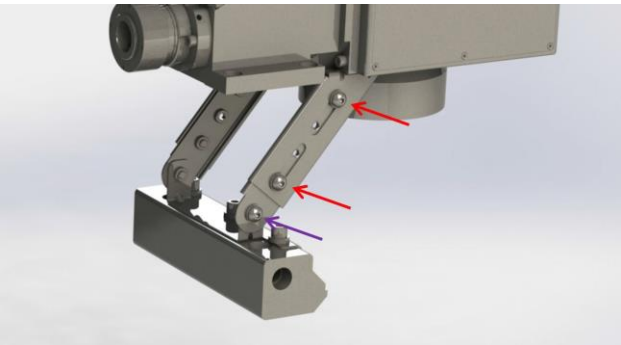
To mount an air knife to the Mid-Power Scanner, please refer to the following procedure.

1. Mount the air knife assembly to the mounting holes located on the bottom of the scan head using two bolts (blue arrows in Figure 5-1). The air knife assembly can be mounted to face any direction in the field of view.

Figure 5-1 Mid-Power Scanner Air Knife Mount

2. Adjust the angle of the air knife by loosening bolts outlined in Figure 5-2 (purple arrow).
3. Adjust the slide assembly by loosening bolts outlined in Figure 5-2 (red arrows)
    a. For optimal protection. The air knife should be positioned well below the coverslide.

Figure 5-2 Mid-Power Scanner Air Knife Adjustment



5.1.2 High-Power Scanner Air Knife Configurations

Two types of air knife are offered for the 2D High-Power Scanner which include a 7in circular air knife and a 9in linear air knife. Each air knife has specific advantages and disadvantages.

- 7in Circular Air Knife
    - Advantage: Good for plume suppression (welding) and removal of debris at the work surface (ablation/marking). This air knife can be especially helpful when tooling is complex and no plume suppression is incorporated into the fixture.
    - Disadvantage: Offers decreased coverslide protection in comparison to the 9in linear air knife.
- 9in Linear Air Knife
    - Advantage: Provides increased coverslide protection in comparison to the 7in circular air knife. Numerous 9in linear air knife can be mounted to a single mounting bracket. This can help to provide additional coverslide protection.
    - Disadvantage: Does not provide the same level of plume suppression that the 7in circular air knife offers. Users will likely want to incorporate plume suppression into fixturing if only using linear air knife.

Air knife mounting brackets allow the user to customize the air knife configuration based on the applications requirements. Figure 5-3 displays a few options for which users can setup air knife configurations.

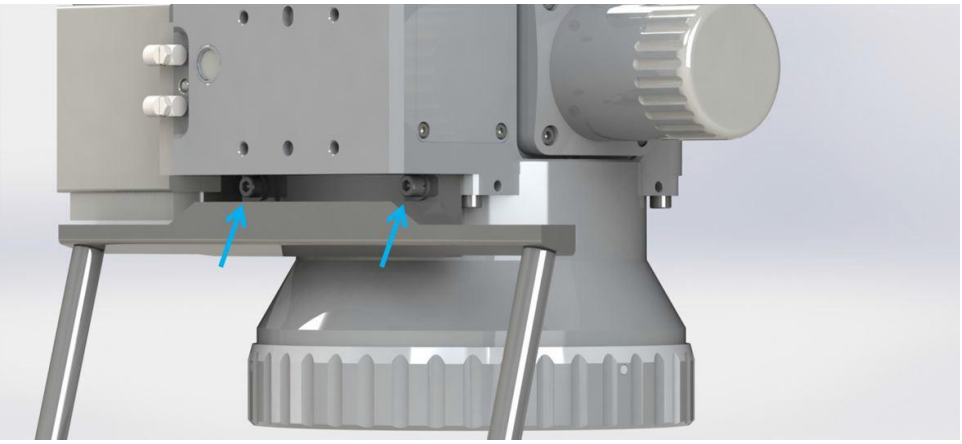
Figure 5-3 2D High-Power Scanner Air Knife Mounting Examples

5.1.3 High-Power Scanner Mounting

To mount an air knife to a 2D High-Power Scanner, refer to the following procedure.

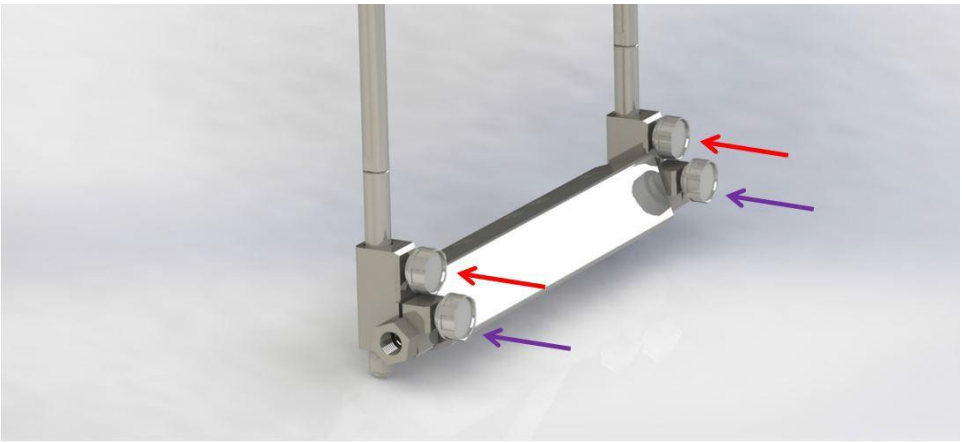
1. Mount one or more air knives to the mounting holes located on the front, left side or back of the 2D Scanner Head (see Figure 5-4).

Figure 5-4 High-Power Scanner Air Knife Mount



2. Adjust the angle of the air knife by loosening clamps (see purple arrows in Figure 5-5).
3. Loosen the set screws and slide the assembly into the desired position and re-tighten the set screws (see red arrows in Figure 5-5).
    a. For optimal protection, the air knife should be positioned well below the cover slide assembly.

Figure 5-5 High-Power Scanner Air Knife Adjustment



5.2 Installing a Digital Camera

5.2.1 Overview

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

IPG Photonics offers three variations of cameras; HDMI Camera, Ethernet Camera, and USB Camera. All cameras can be mounted to IPG Scanning Optics through the use of a Camera Arm Module.

IPG supplied cameras are not intended to be used as vision systems (i.e. they cannot capture and calculate positional offset values). They are intended for through the lens visualization only. A third party camera and/or software would be required for capturing positional offset data.

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

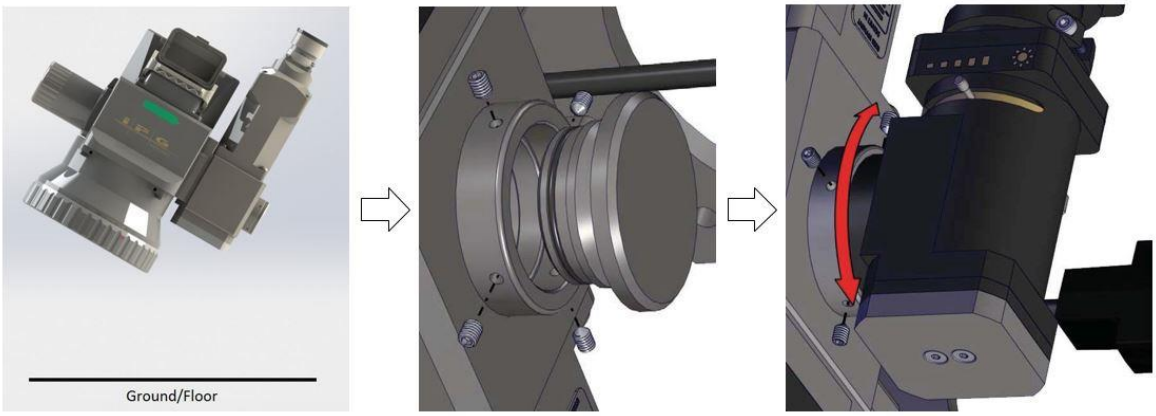
IMPORTANT **Camera installations should be performed in as clean of an area as possible (i.e in an office area).**

5.2.2 Installation and Setup

The following instructions detail the installation of a digital camera. Although the images depict the 2D High-Power Scanner, the same principles apply to the installation of a camera with a Mid-Power Scanner.

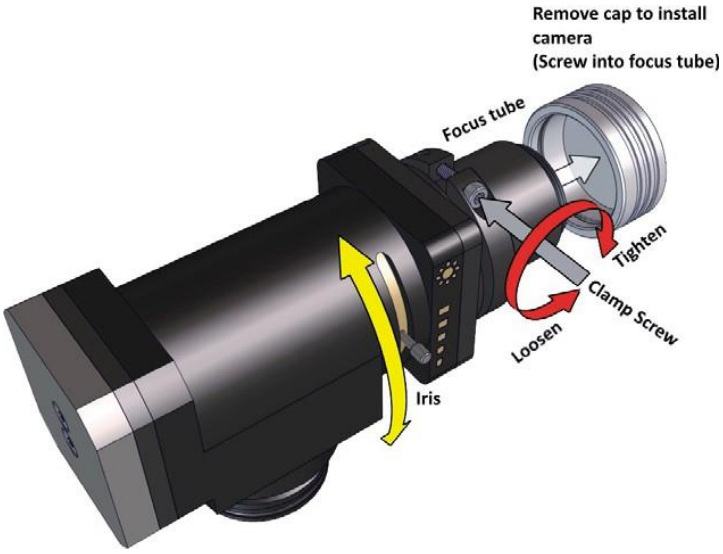
1. Tilt the scan head so the camera port is angled slightly down towards the ground.
    a. This is done to help prevent any falling debris that may be in the air from entering the head.
2. Using a 1.5mm Allen Wrench, loosen the four set screws holding the plug in place.
    a. Have the camera ready to install shortly after removing the camera plug. The less time the head is open to the environment, the better.
3. Remove the plug and store it in a safe place.
4. Insert the camera arm into the open port.
    a. The camera arm is normally positioned parallel to the collimator, although, it can be positioned off axis.
    b. Figure 5-6 details steps 1 through 4.

Figure 5-6 Installing a Digital Camera



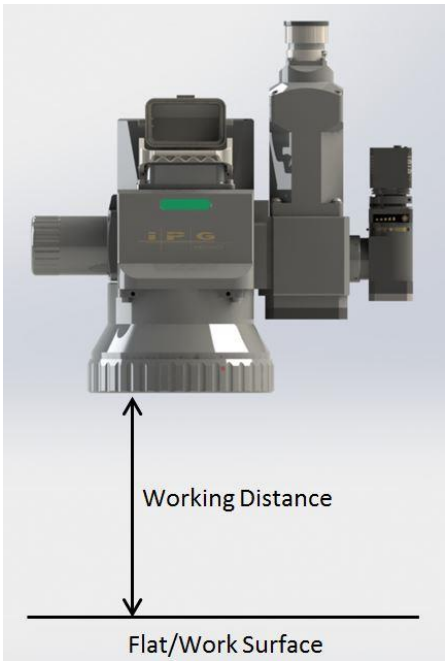
5. Tighten the four set screws.
6. Remove the white cap on the camera arm and screw on any C-mount style camera to the focus tube. Figure 5-7 shows the Camera Arm Module and the removal of the white cap.

Figure 5-7 Camera Arm Module (Horizontal)



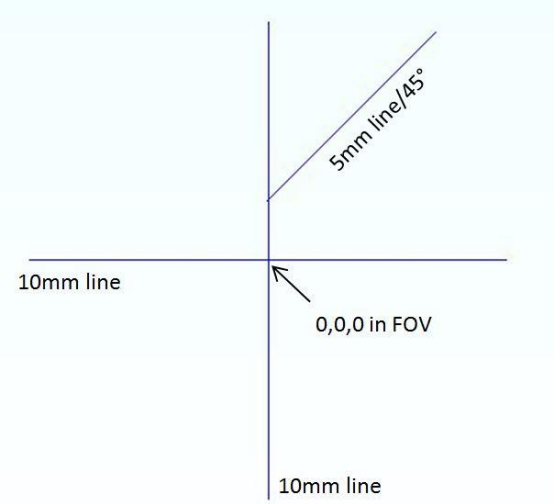
7. With the Camera Arm Module and Camera installed, rotate the head so it is perpendicular to the ground and/or work surface.
8. Set the head to the proper Working Distance.
    a. Working distances can be found in the section, Product Specifications, for each scanner and lens combination.
    b. Figure 5-8 details steps 7 and 8.

Figure 5-8 Setting the Working Distance



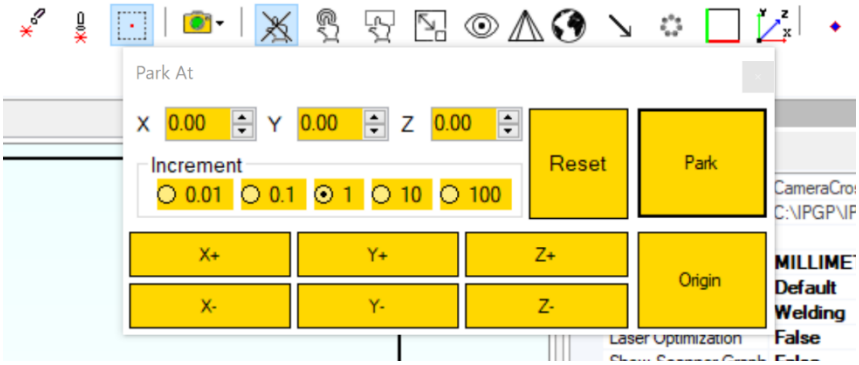
9. Using IPGScan software, mark a cross (as seen in Figure 5-9) at 0, 0, 0 in the scanners Field of View (FOV). Once marked, make sure the head is not moved from this position until camera setup is complete.
    a. This cross will be used to determine camera orientation, set focus, and align cross-hairs.
    b. Please refer to the IPGScan Manual (DOCOXUGGUIXX0001) for IPGScan operation.

Figure 5-9 IPGScan Camera Alignment Cross



10. Power on the camera using the supplied power cable.
    a. Some Ethernet cameras utilize Power over Ethernet (POE).
11. Connect the camera to the proper interface.
    a. HDMI Cameras will interface with a monitor/TV over an HDMI interface.
    b. USB Cameras are made to interface with a computer, but do not interface with IPGScan Software.
    c. Ethernet Cameras interface with a computer and can be utilized inside of IPGScan Software. Please refer to the IPGScan Manual (DOCOXUGGUIXX0001) for additional setup information and features.
        i. Ethernet cameras require a firmware version of 2.0201 installed.
12. Set the scanner so the mirrors are parked at 0, 0, 0 in the FOV using IPGScan software. The following outlines a method of doing this but users can also refer to the IPGScan Manual (DOCOXUGGUIXX0001).
    a. Open the “Park At” window and ensure the prompt window is set to 0, 0, 0 and click “Park” or click “Origin.” See Figure 5-10.

Figure 5-10 Park At Window in IPGScan

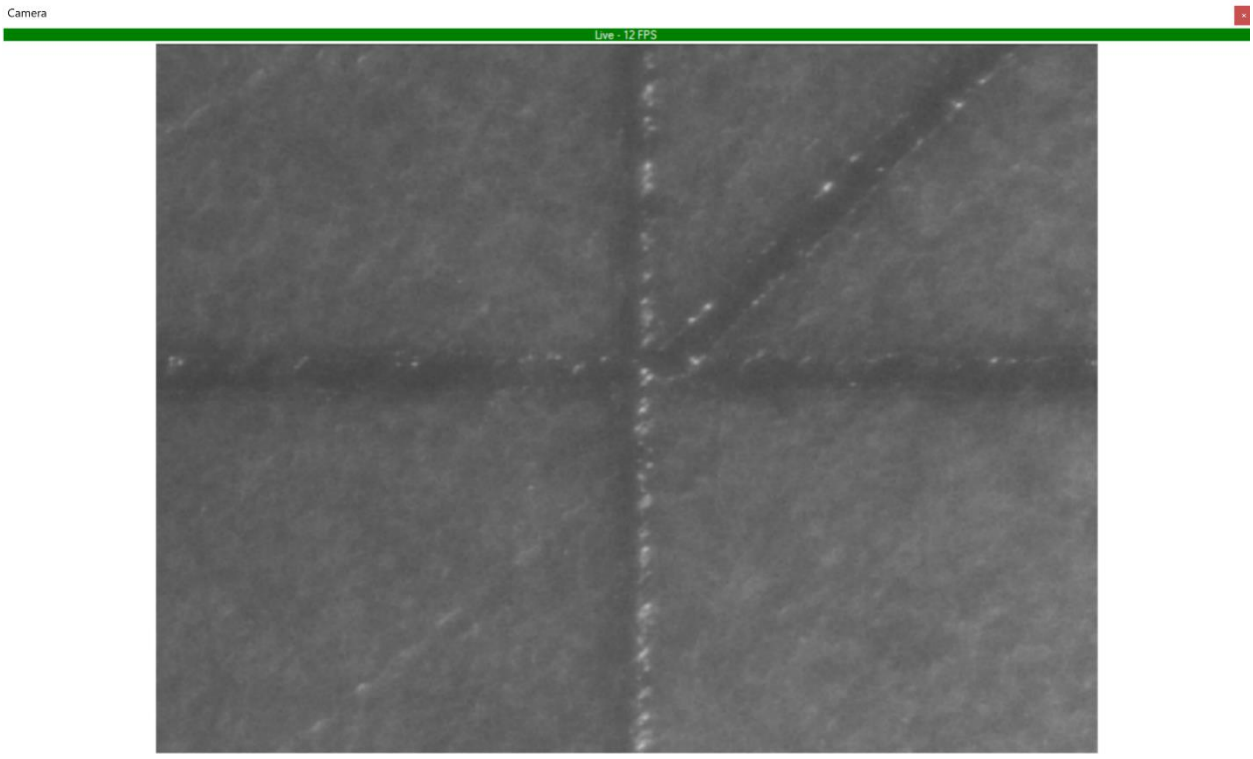


13. Focus the camera image and set brightness
    a. As detailed in Figure 5-7, loosen the Clamp Screw and slide the Focus Tube up and down until the image is in focus. Once the desired focus position is found, tighten the Clamp Screw. The Iris can be adjusted in order to change brightness.
    b. If the camera image is dark even after adjusting the Iris, ensure that there is adequate light on the work surface.
    c. Additional settings are available to change exposure and other common camera settings.
        i. For the HD camera, plug the provided controller into the camera and follow the onscreen menu items.
        ii. For the USB camera, adjustments are made on the computer.
        iii. Ethernet camera adjustments are made in IPGScan (Please refer to the IPGScan Manual [DOCOXUGGUIXX0001] for additional detials).
14. Center the camera image (This may not be required) using the adjustment screws on the camera arm.
    a. Remove the cover as shown in Figure 5-11.
    b. Carefully adjust the four setscrews until the image is centered in the camera view as desired. Always back out the adjustment screw slightly that is opposite of the one that is to be tightened. These adjustment screws should not be overtightened.
    c. Once the image is centered as desired, screw the cover plate back into place.

Figure 5-11 Camera Arm Module Image Adjustment

15. Once adjustments have been made, the image should look similar to what is pictured in Figure 5-12.

Figure 5-12 Aligned Camera Image



16. Users can now modify image settings and add crosshairs as desired.
    a. For the HD camera, plug the provided controller into the camera and follow the onscreen menu items.
    b. For the USB camera, adjustments are made on the computer.
    c. Ethernet camera adjustments are made in IPGScan.

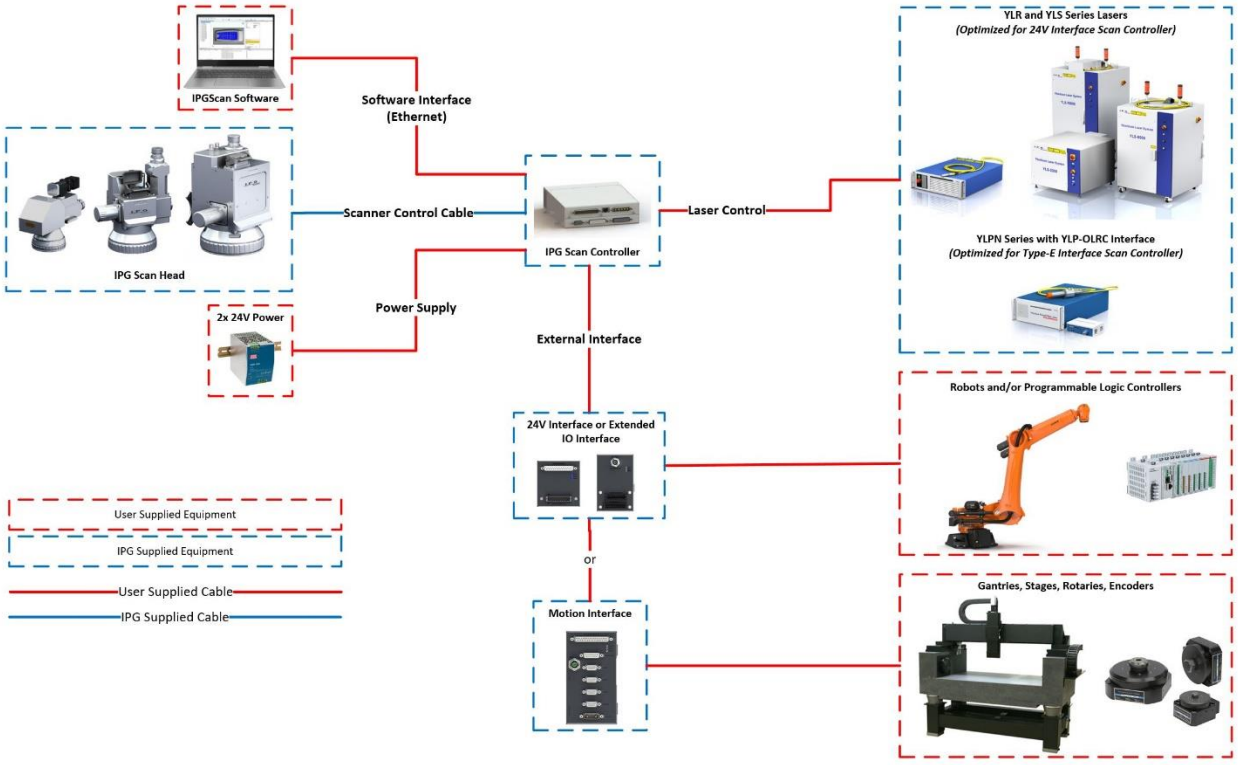
6 Electrical Connections

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

6.1 IPG Scan Controller Connections

The IPG Scan Controller is designed to allow users to interface with a number of different devices. Not only does this include the scan head and a PC for programming, but it also includes the laser and whatever industrial controls the application requires. Figure 6-1 provides a high-level overview of where the Scan Controller fits within the system integration.

Figure 6-1 General IPG Scan Controller System Layout



Please refer to Figure 6-2 and Table 6-1 for an overview of each connector on the Scan Controller.

Figure 6-2 IPG Scan Controller Connections

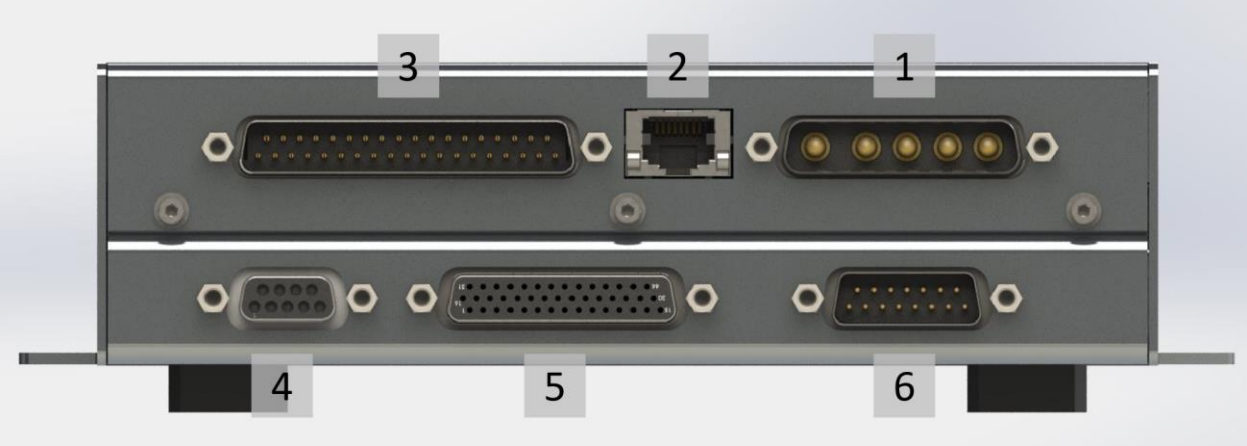


Table 6-1 IPG Scan Controller Connections

Connector Number	Connector Type	Description
1	DB 5W5 - Male	Power supply
2	RJ45	Ethernet communications between the Scan Controller and PC
3	DB 37 - Male	External control interface connector (User I/O)
4	DB 9 - Female	RS232 Serial connector for controller troubleshooting
5	DB 44 - Female	Digital communication with the scan head
6	DB 15 - Male Or DB 25 - Female	Laser control interface. Connector is dependent on the laser model used with the scanner

WARNING: Always ensure that the Scan Controller power supplies are powered down when plugging-in or unplugging cables.

Each connection is detailed further in the following sections.

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.

6.1.1.1 Power Pinouts

Figure 6-3 Male DB 5W5 Connector

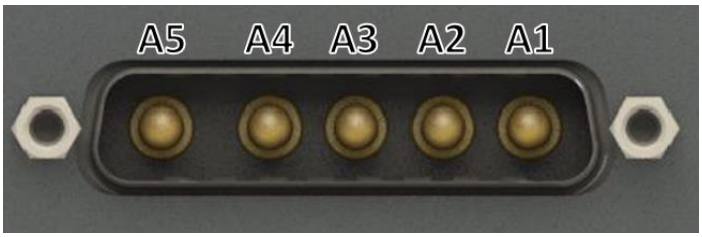


Table 6-2 IPG Scan Controller DB 5W5 Pinout

Pin	Function	Description
A1	Not Used	Not used. Do not connect this pin to ground.
A2	+24VDC (House Keeping)	Power for electronics/communications (House Keeping)
A3	24V Return (House Keeping)	
A4	+24VDC (Galvo Power)	Isolated Galvo Power
A5	24V Return (Galvo Power)	

IMPORTANT **GALVO POWER MUST BE ISOLATED. DO NOT CONNECT GALVO POWER SUPPLY RETURN TO EARTH GROUND OR TO HOUSE KEEPING RETURN.**

Table 6-3 Example Mating Connector Components - Power

Item	Description	Digi-Key Part Number
D-Sub Contacts	D-Sub Contact Female Socket Gold 12 AWG Solder Cup	609-1441-ND
D-Sub Receptacle	Receptacle for Female Contacts Housing D-Sub, Combo Connector 5	609-1521-ND
Backshell	25 Position Two Piece Backshell Connector Silver 180˚ Shielded	925ZE-ND

6.1.1.2 Power Requirements

IPG recommends the use of two separate power supplies for providing power to the Scan Controller. Table 6-4 outlines the power requirements of the Scan Controller.

Table 6-4 IPG Scan Controller Power Requirements

Power Supply	Current Rating	Voltage Rating
House Keeping Power	Minimum 1A	24V ±5%
Galvo Power	10A Peak / 2A Average	24V to 30V ±5%

IMPORTANT **Be mindful of voltage drop as the length of power supply cables increases.**

6.1.1.3 Example Power Supply Configurations

Please refer to the following figures for power supply configurations depending on the laser being used.

Figure 6-4 Power Supply Configuration - YLR or YLPN Lasers

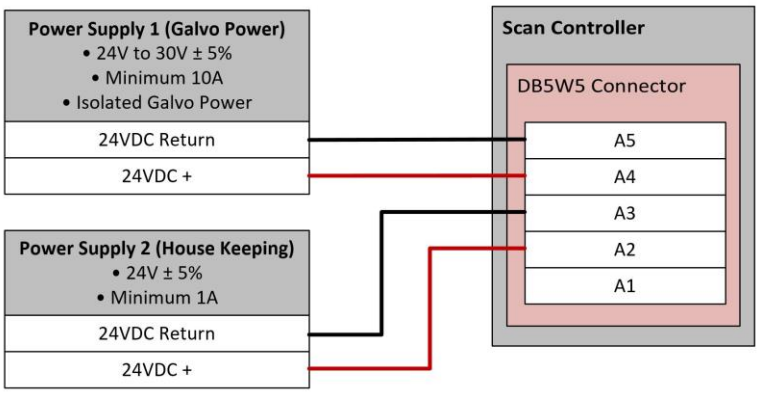


Figure 6-5 Power Supply Configuration - YLS Laser (with Hardwire Interface)

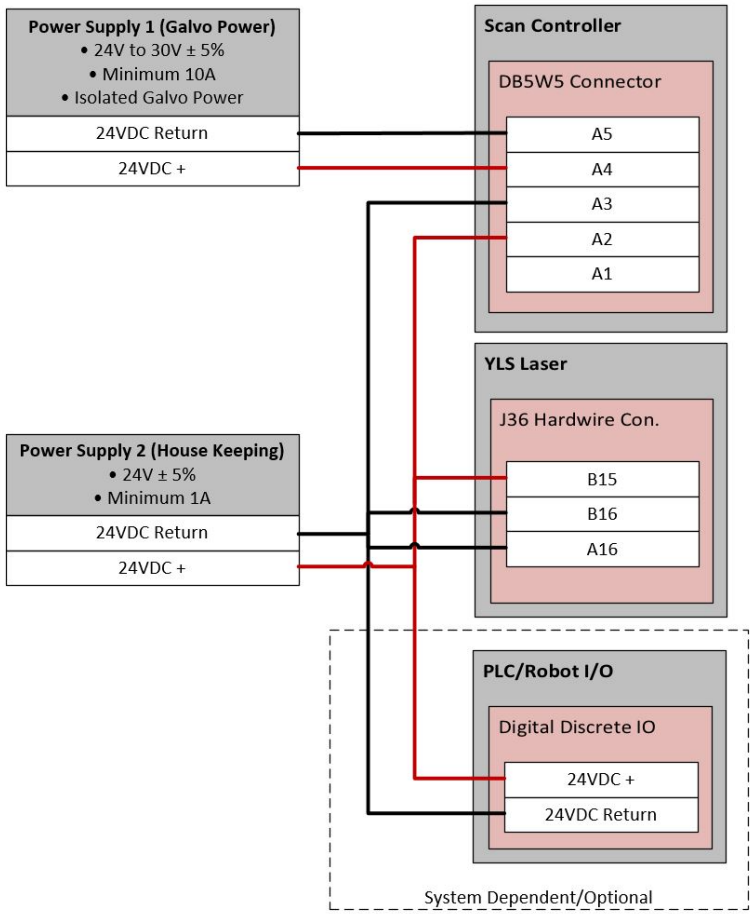
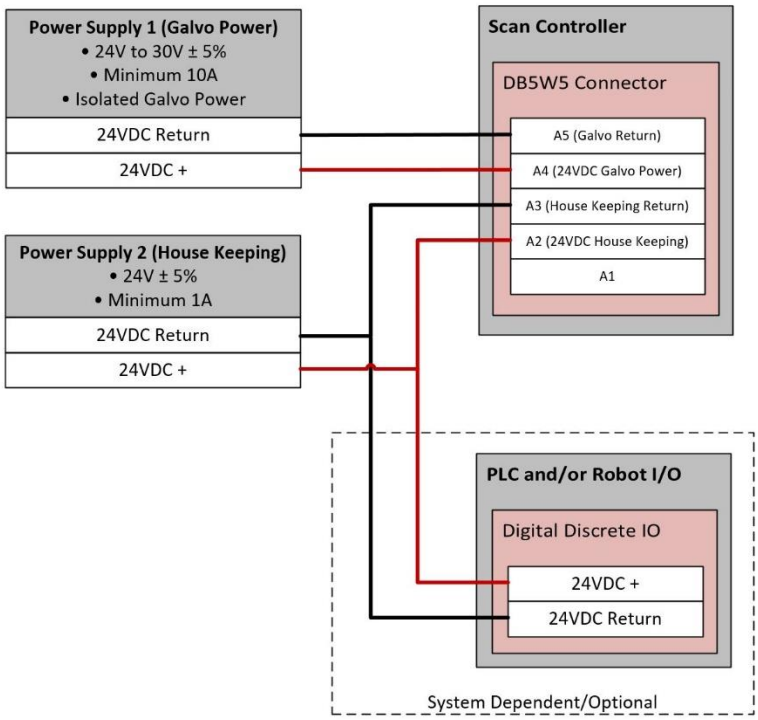


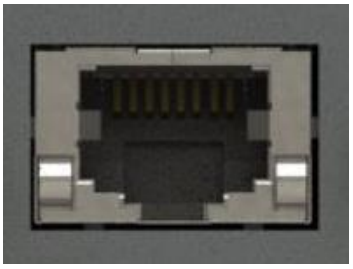
Figure 6-6 Power Supply Configuration - YLS Laser (with Fieldbus Interface)



6.1.2 Ethernet

The Ethernet port is used for all communication between the Scan Controller and the host PC running IPGScan. Users have no access to the protocol data going through this line.

Figure 6-7 RJ45 Ethernet Connector



The 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 100 Mbits/sec.

Table 6-5 - Recommended Ethernet Cable Specifications

Item	Specification
Category	Cat 5e or Greater
Wiring Standard	Straight-Through (T568A to T568A **or** T568B to T568B)

6.1.3 External Interface

The External Interface connector (User I/O) is for external control of the Scan Controller through means of digital communication with devices such as PLCs, robots, or encoders/motors. This interface provides users with a means to trigger when the scanner should start processing as well as a number of other functions related to automating the system.

Figure 6-8 Male DB 37 Connector

I/O signals out of this connector are either 3.3VTTL or RS422 compatible. Bidirectional I/O signals are not isolated and IPG does not recommend direct connection with them. To properly integrate the Scan Controller into an automated system, an External Interface Device such as the 24V Interface, Extended IO Interface, or Motion Interface should be utilized. Please refer to the External Interface Board User Guide (DOCOXUGSCNXX0002) for additional details.

6.1.4 RS232 Serial

The RS232 connector is used as troubleshooting connection to the Scan Controller. This port can be used to reset the IP address of the Scan Controller if the user ever forgets what the assigned IP address is.

Figure 6-9 Female DB 9 / RS232 Connector

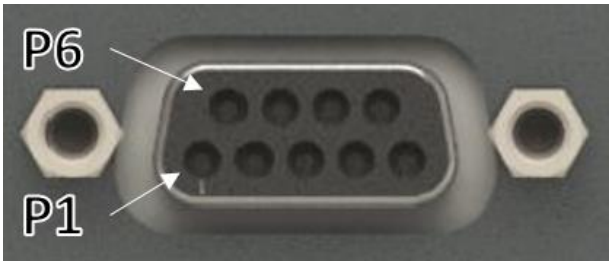


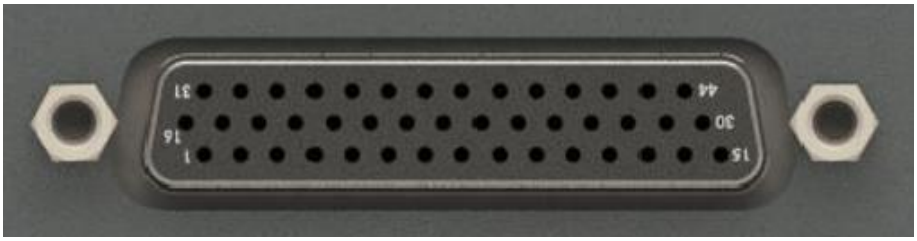
Table 6-6 Serial Pinout

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 utilized here. Users are not allowed to interface with this connector.

Figure 6-10 Female DB 44 Connector



6.1.6 Laser Control

This connection allows communication with the laser. This connector can be either a DB 15 or a DB 25 pin connector depending on the laser to be controlled.

The DB 15 version has an analog power control signal and is used with YLS and YLR laser types. Refer to Table 6-7 for the corresponding DB 15 pinouts. The DB 25 version has digital power control signals and is used with YLPN lasers with a Type E interface. Refer to Table 6-9 for DB 25 connector pinouts.

Actual wiring between Scan Controller and laser source is shown in Section 7.

Figure 6-11 Male DB 15 Connector (24V Laser Interface Connector)

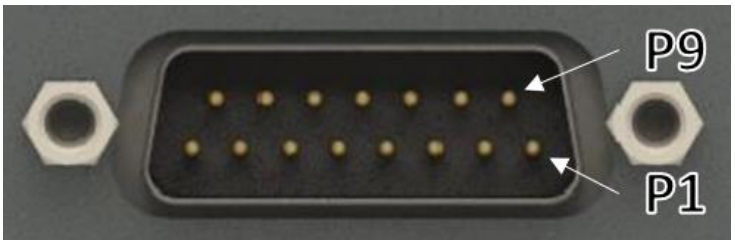


Table 6-7 DB 15 Pinout

Pin	Direction	Level	Description
1	Output	0-10V	Analog Control + For use with non-AMB lasers Core power control on AMB lasers
9			Analog Control Return Pins 9, 10, 5, and 7 are all common
2	Output	24V	Modulation +
10			Modulation Return Pins 9, 10, 5, and 7 are all common
3	Output	24V	Guide Control
11	Output	24V	Program Start/Emission Enable
4	Input	24V	Power Supply Active
12	Input	24V	Error/Ready
5		GND	Common Return Pins 9, 10, 5, and 7 are all common
13	Input	24V	Emission On
6	Output	24V	Gate
14	Input	0-10V	Laser Power Feedback
7		GND	Common Return Pins 9, 10, 5, and 7 are all common
15	Output	0-10V	Analog Control + (AMB Ring Control) Do not use on non-AMB lasers
8	Input	Dry Contact	Air Pressure Present Contact closure to GND when air pressure present

Table 6-8 Example Mating Connectors – DB 15 Laser Control

Item	Description	McMaster Part Number
DB 15 Connector Assembly - Solder	D-Sub Straight Connector, Solder, Shielded Socket, DB15, Female, for 30-20 Wire Gauge	2146T53
DB 15 Connector Assembly – Crimp	D-Sub Straight Connector, Crimp-On, Shielded Socket, DB15, Female, for 28-24 Wire Gauge	94575T18

Figure 6-12 Female DB 25 Connector (Type-E Laser Interface Connector)

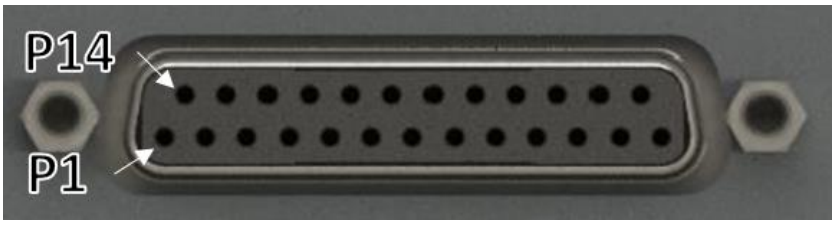


Table 6-9 DB 25 Pinout

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 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 Scanner Only)

Figure 6-13 XY2-100 Connections

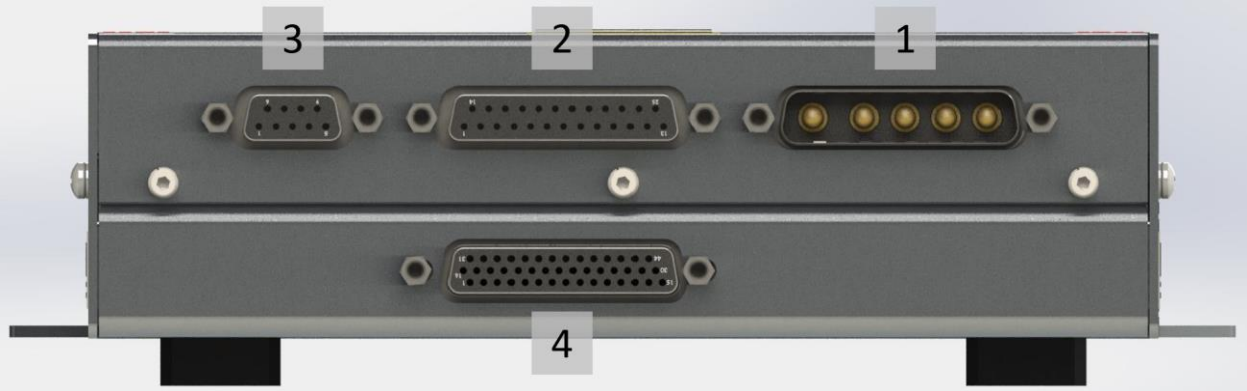


Table 6-10 XY2-100 In/Out Connector Descriptions

Connector Number	Connector Type	Description
1	DB 5W5 - Male	Power supply
2	DB 25 - Female	XY2-100 Digital Signals
3	DB 9 - Female	Auxiliary IO
4	DB 44 - 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 6-14 Male DB5W5 Connector

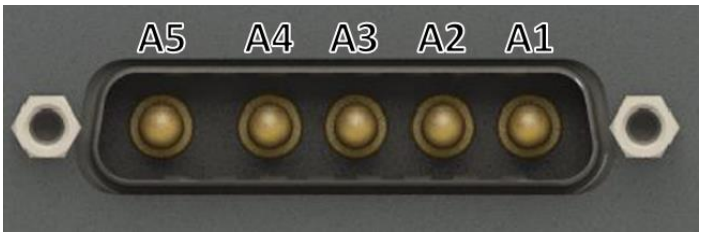


Table 6-11 XY2-100 DB 5W5 Pinout

Pin	Function	Description
A1	Not Used	Not used. Do not connect this pin to ground.
A2	+24VDC (House Keeping)	Power for electronics/communications (House Keeping)
A3	24V Return (House Keeping)	
A4	+24VDC (Galvo Power)	Isolated Galvo Power
A5	24V Return (Galvo Power)	

Table 6-12 Example Mating Connector Components (XY2-100 Power)

Item	Description	Digi-Key Part Number
D-Sub Contacts	D-Sub Contact Female Socket Gold 12 AWG Solder Cup	609-1441-ND
D-Sub Receptacle	Receptacle for Female Contacts Housing D-Sub, Combo Connector 5	609-1521-ND
Backshell	25 Position Two Piece Backshell Connector Silver 180˚ Shielded	925ZE-ND

6.2.1.2 Power Requirements

Table 6-13 XY2-100 Power Requirements

Power Supply	Current Rating	Voltage Rating
House Keeping Power	Minimum 1A	24V ±5%
Galvo Power	10A Peak / 2A Average	24V to 30V ±5%

IMPORTANT

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.

6.2.1.3 Example Power Supply Configurations

Please refer to the following figures for power supply configurations depending on the laser being used.

Figure 6-15 Scanner with YLS Power Supply Configuration

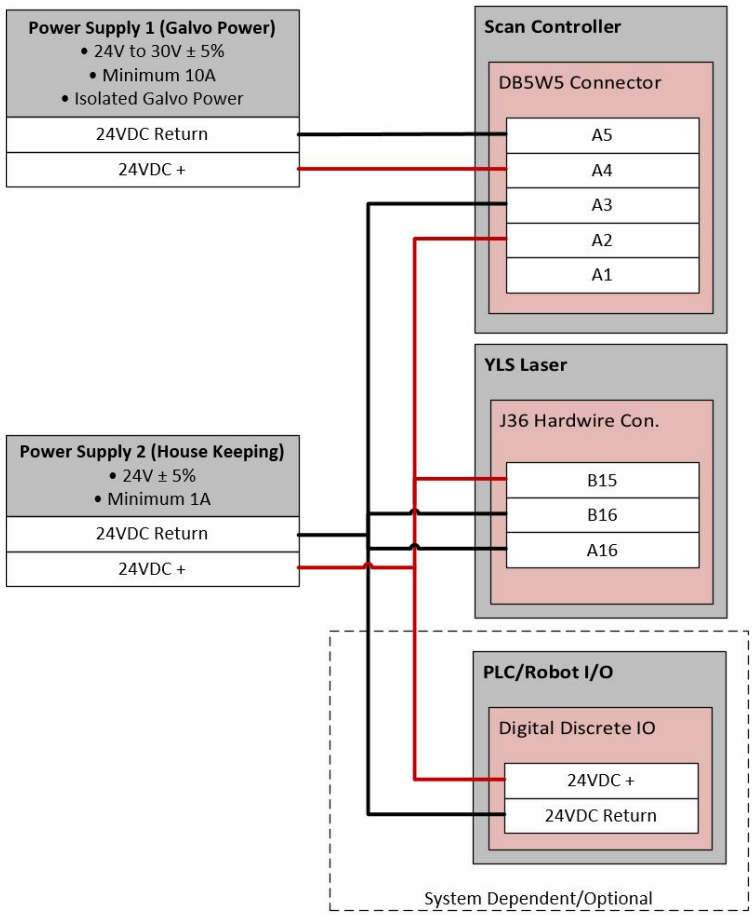


Figure 6-16 Scanner with YLR Power Supply Configuration

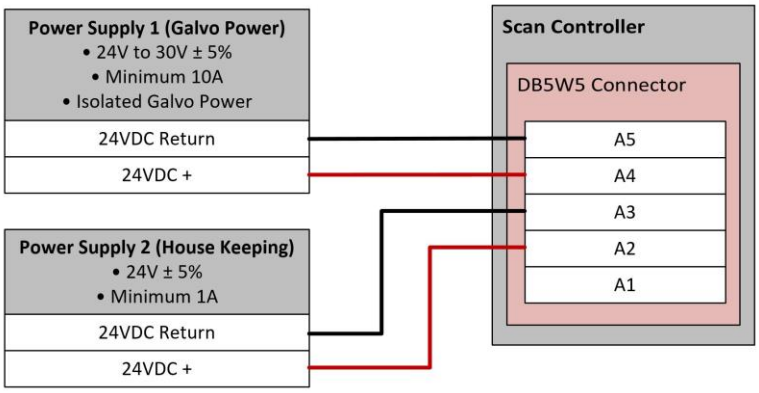
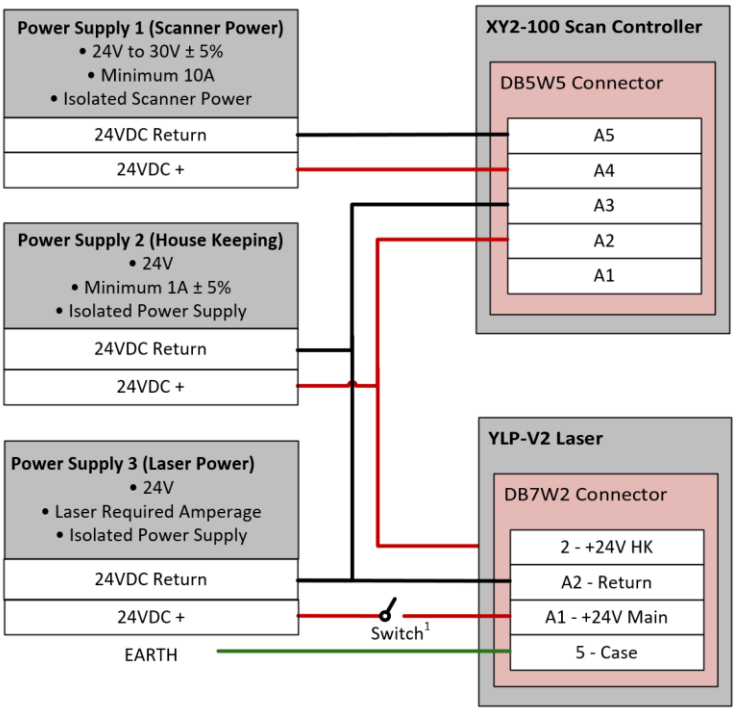


Figure 6-17 Scanner with YLP Power Supply Configuration



Notes:
1. Switch to control Laser Power (safety). Approximately .5 sec startup time upon power-up.

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. For Mid-Power Scanner with XY2-100 Interface applications, the user is responsible for configuring communications to the scanner. Scanner control and status should be communicated through this DB 25 female connector.

Figure 6-18 Female DB 25 Connector (XY2-100)

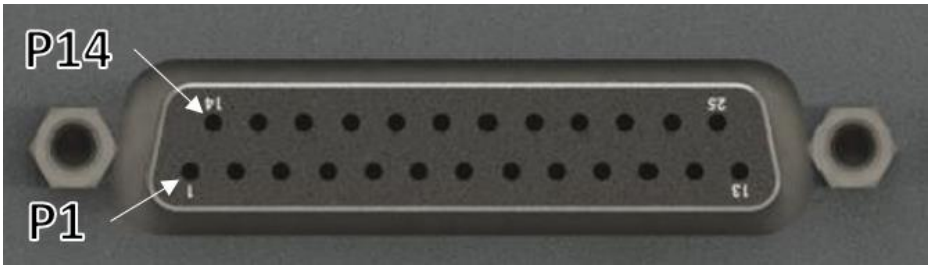


Table 6-14 XY2-100 Digital Signal Pinouts

Pin	Name	Direction	Description
1	CK-	Input	2Mhz Clock
14	CK+	Input	
2	SYNC-	Input	Sync Signal
15	SYNC+	Input	
3	XD-	Input	X Channel Data
16	XD+	Input	
4	YD-	Input	Y Channel Data
17	YD+	Input	
5	ZD-	Input	Z Channel Data (If Z axis is present)
18	ZD+	Input	
6	STAT-	Output	XY2-100 Status Word
19	STAT+	Output	
7	NC	-	Do not connect
20	NC		
8	NC	-	Do not connect
21	NC		
9	+V Servo	PWR	Do not connect
22			
10			
23	GND	PWR	Do not connect
11			
24			
12	-V Servo	PWR	Do not connect
25			
13			

6.2.3 Auxiliary I/O

Table 6-15 outlines the auxiliary I/O pinouts on the XY2-100 interface. This connector provides an alternative input to control the guide beam.

Figure 6-19 Female DB 9 Connector (XY2-100)

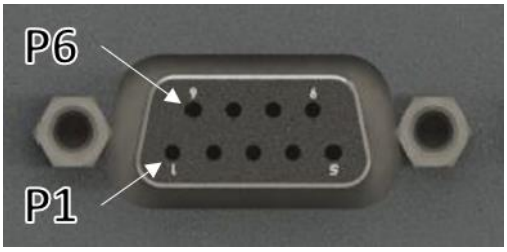


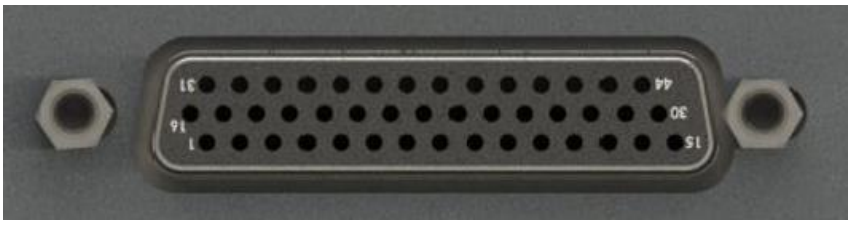
Table 6-15 XY2-100 Auxiliary I/O Pinouts

Pin	Name	Description
1	A1	Not used in this configuration
6	A2	
2	B1	Not used in this configuration
7	B2	
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	Do Not Connect

6.2.4 Scanner Control

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

Figure 6-20 Female DB 44 Connector (XY2-100)



7 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 the laser.**

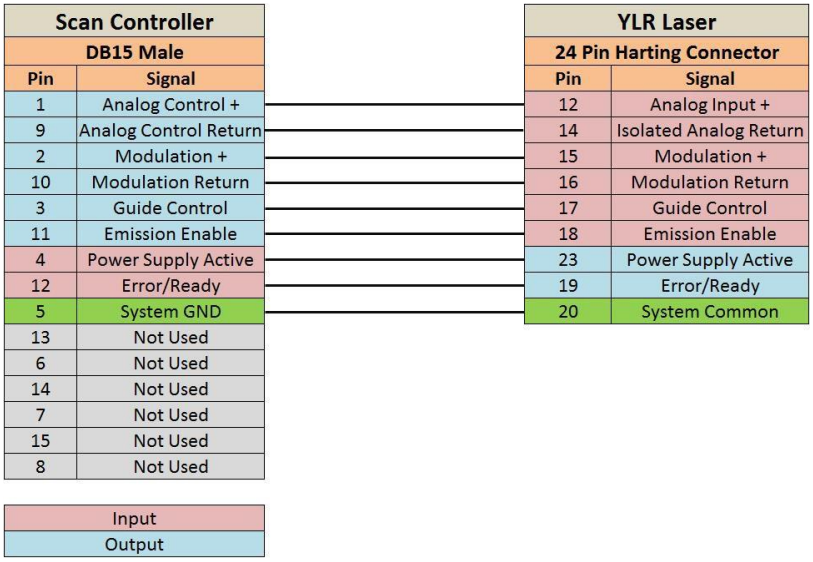
7.2 YLR Series Lasers

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



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

1. Turn the key switch on the laser to **ON**.
2. Using the touch screen, set the laser to Q**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**.

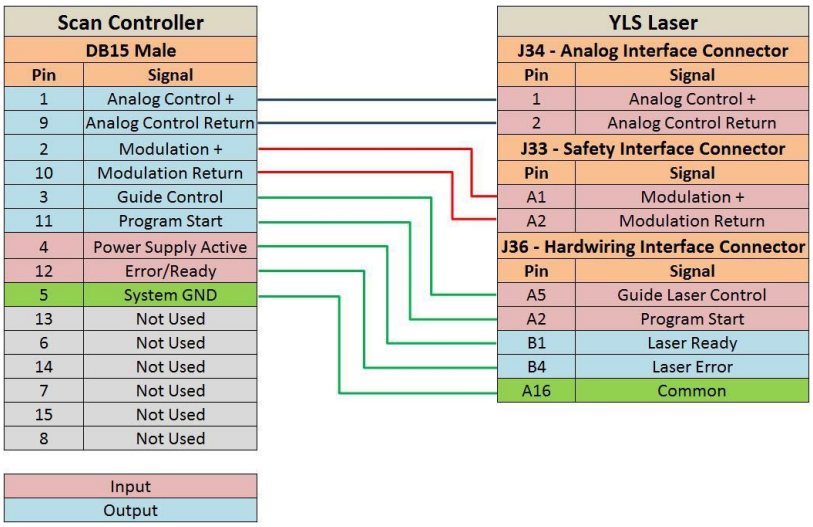
7.3 YLS Series Lasers

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 (with Hardwire Interface) Connections

Please refer to Figure 7-2 for Scan Controller to YLS Series laser connections. This configuration assumes a YLS Series laser that has a hardwire interface.

Figure 7-2 Scan Controller to YLS Laser (Hardwire Interface) Connections

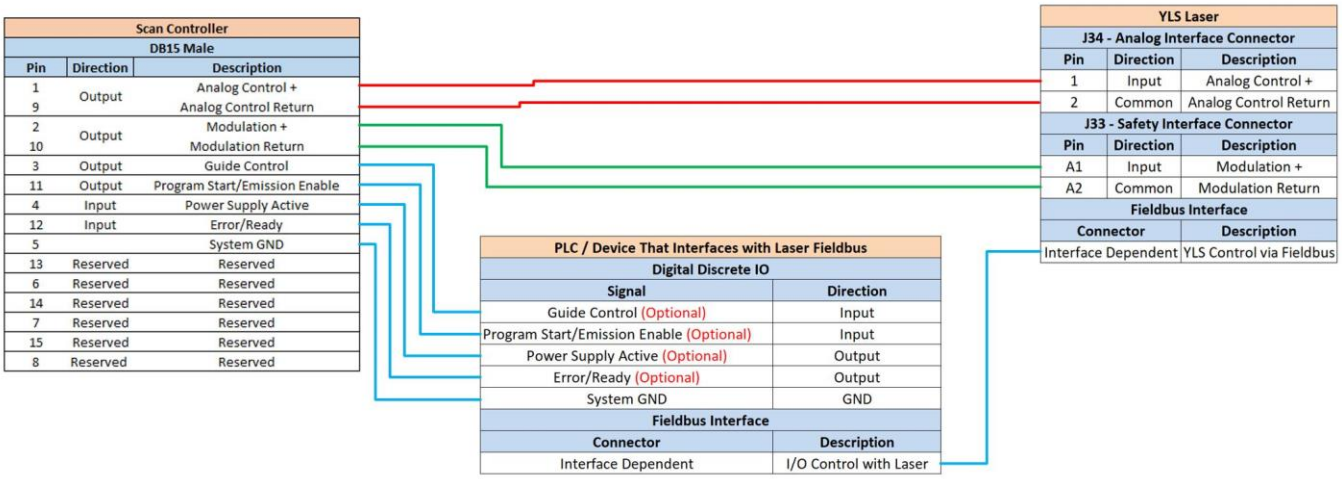


IMPORTANT **Laser Error Signal: Users who have previously integrated IPG Lasers may be custom to using the Laser Error signal for PLC/System logic. If users would still prefer to do this, please contact an IPG Product Specialist.**

7.3.2 Scan Controller to YLS Series Laser (with Fieldbus Interface) Connections

Figure 7-3 outlines an example setup between an IPG Scan Controller (with 24V Laser Interface) and YLS-Series Laser utilizing a Fieldbus Interface.

Figure 7-3 Scan Controller to YLS Laser (Fieldbus Interface) Connections



Scan Controller		
DB15 Male		
Pin	Direction	Description
1 9	Output	Analog Control + Analog Control Return
2 10	Output	Modulation + Modulation Return
3	Output	Guide Control
11	Output	Program Start/Emission Enable
4	Input	Power Supply Active
12	Input	Error/Ready
5		System GND
13	Reserved	Reserved
6	Reserved	Reserved
14	Reserved	Reserved
7	Reserved	Reserved
15	Reserved	Reserved
8	Reserved	Reserved

PLC / Device That Interfaces with Laser Fieldbus	
Digital Discrete IO	
Signal	Direction
Guide Control (Optional)	Input
Program Start/Emission Enable (Optional)	Input
Power Supply Active (Optional)	Output
Error/Ready (Optional)	Output
System GND	GND
Fieldbus Interface	
Connector	Description
Interface Dependent	I/O Control with Laser

YLS Laser		
J34 - Analog Interface Connector		
Pin	Direction	Description
1	Input	Analog Control +
2	Common	Analog Control Return
J33 - Safety Interface Connector		
Pin	Direction	Description
A1	Input	Modulation +
A2	Common	Modulation Return
Fieldbus Interface		
Connector		Description
Interface Dependent		YLS Control via Fieldbus

The following is important to note concerning system operation:

- The PLC acts as a pass-through in the above example and simply converts Scan Controller/Laser signals accordingly.
- None of the signals that are passed through the PLC from the scanner are actually required. It is possible to operate the system without these signals but the following should be noted:
    - **Guide Control** – The scanner/IPGScan will no longer control the guide laser ON/OFF. This means that the user will need to enable the guide laser on the Laser instead of the scanner controlling it when previewing process objects.
    - **Program Start/Emission Enable** – Program Start is commonly required to be set active prior to the YLS laser firing. The scanner can control this (and does by setting Program Start Active at the start of every process object) via the hardwire interface but it is recommended that the users set this active at the start of their process when using the Fieldbus interface on a YLS series laser (and leave it active throughout the process).

Note that if External Control is not set to ON and the laser is armed, the laser will fire if a commanded power is sent to the laser and Program Start is set active. ALWAYS EXERCISE SAFE LASER PRACTICES WHEN ATTEMPTING TO ARM AND/OR FIRE THE LASER.

    - **Power Supply Active & Error/Ready** – Both signals are used to set laser status messages in IPGScan. Although these signals are not required in order to operate the scanner, the user will have error/interlock messages in IPGScan even when the laser is properly armed and ready for processing if these signals are not connected.

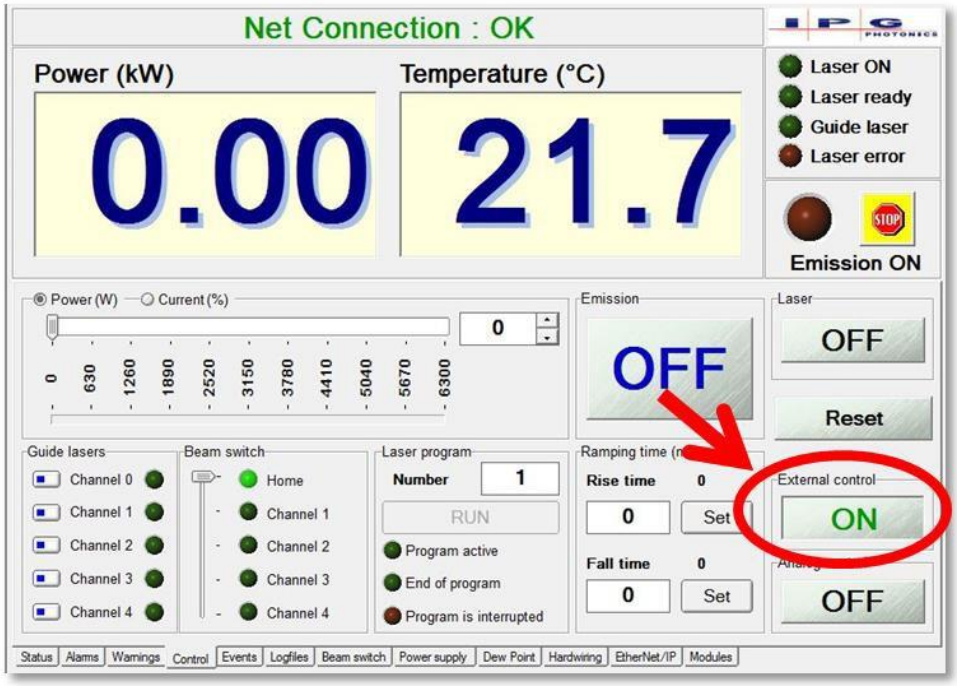
7.3.3 YLS Laser Source Setup

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 7-4.
4. Turn the key switch on the laser to **REM**.

Figure 7-4 YLS External Control ON



7.4 YLPN Series Lasers

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

In order to achieve optimal synchronization between a pulsed laser and scanner, the following equipment should be utilized.

- YLP-OLRC Interface
  - This laser control box provides the interface connection (Parallel I/O) that allows the Scan Controller to drive the laser.
  - Refer to the lasers manual for additional detail.
- Scan Controller with Type E Laser Interface

7.4.1 Scan Controller to YLPN Series Laser Connections

The following table (Table 7-1) outlines the Scan Controller laser connector and the YLPN (YLP-OLRC) connector. The connection is a 1-to-1 DB 25 Male/Female. See Figure 7-5 which details the connection.

Table 7-1 Scan Controller (Type-E Laser Interface) and YLP-OLRC Connectors

Scan Controller (Type-E Laser Interface)	YLP-OLRC (Parallel I/O Interface)
DB 25 - Female Connector	DB 25 - Male Connector

Figure 7-5 Scan Controller to YLP-OLRC Interface Connection

7.4.2 YLPN Laser Source Setup

In order for the scanner to properly control the laser, the following settings should be configured in the laser software.

1. **Laser Options** – The following should be enabled.
   a. YLP-OLRC interfaces
   b. Extended PRR
   c. Sweep PRR
   d. ACON
   e. Auto latch power

2. **Laser Interfaces** – The following outlines the recommended interface settings.
    a. Main interface – Parallel I/O
    b. Power – Main interface
    c. Emission enable – Main interface
    d. Emission modulation – Main interface
    e. Guide Laser ON – Main interface
    f. PRR – Main interface
    g. Power supply – User dependent. Not controlled by Scanner/Scan Controller.
    h. Reset – User dependent. Not controlled by Scanner/Scan Controller.
    i. Laser mode – User dependent. Not controlled by Scanner/Scan Controller.

8 External Control Interfaces

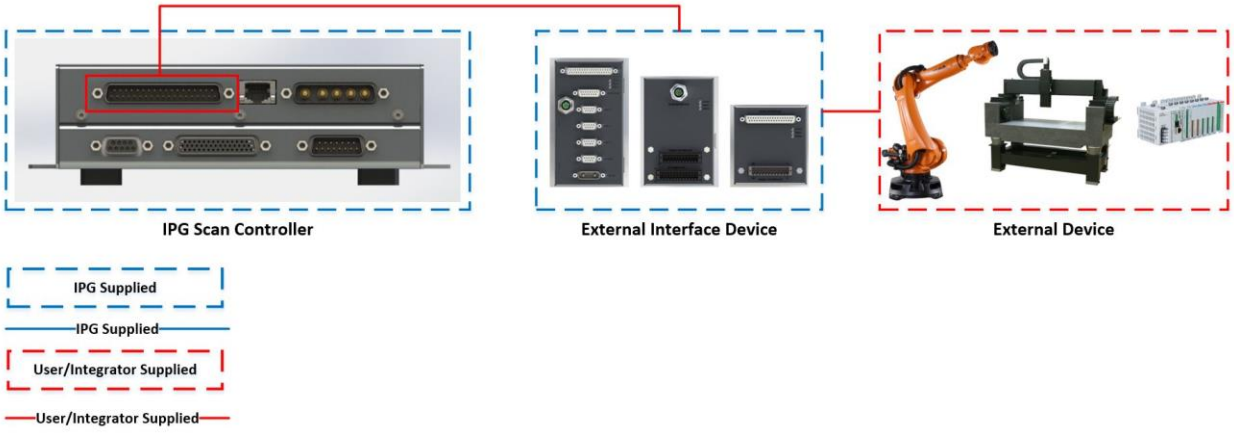
IPG scanning heads are designed with a versatility that allows them to be integrated with a number of automated devices. Examples of these devices include programmable logic controllers (PLCs), robots, and encoder/motors (stages, gantries, rotary devices).

Given that each of these automated devices has unique integration requirements, IPG utilizes various External Interface Boards that allow users to adapt the scanners to the processes needs. The following External Interface Boards are available.

- 24V Interface
  - Commonly used in applications with PLCs and Robots that utilize 24V digital discrete IO.
- Extended IO Interface
  - Commonly used in applications with PLCs and Robots. The Extended IO interface offers more general purpose bits than the 24V Interface and also can operate at logic levels other than 24V.
- Motion Interface
  - Commonly used in applications involving gantries, linear stages, rotaries, and encoder devices. The Motion Interface is designed to work with logic levels of 5V.

For detailed information concerning the integration and use of the available External Interfaces, please refer to the External Interface Board User Guide (DOCOXUGSCNXX0002).

Figure 8-1 General External Interface Overview Diagram



9 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

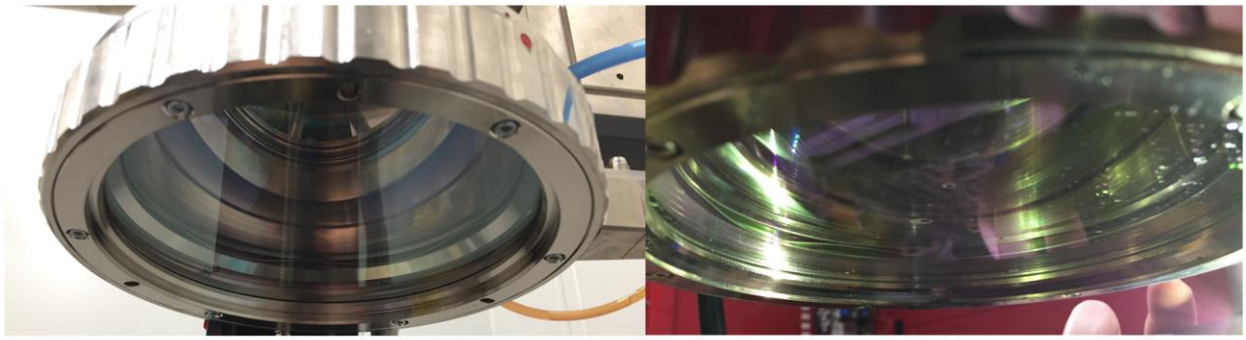
After extended periods of processing, the protective window can become dirty or damaged which can affect the quality of the laser beam. This ultimately can also affect the quality of the process. For Mid and High-Power Scanners, the Window Assembly contains an individual glass element. This glass element is a consumable and is designed to be replaced when it becomes dirty or damaged.

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

Every application has different requirements when it comes to the cleanliness of the protective window. This means that it is up to the user to determine what is too much contamination for their specific process. This can be done through observation of the protective window after so many cycles of the system or the Dirty Window Sensor can be utilized to alert the user when the protective coverslides contamination threshold is exceeded. Figure 9-1 provides two general examples of protective window contamination.

IMPORTANT **The Dirty Window Sensor allows users to setup threshold values based on their specific process. IPG does not provide these thresholds given that they are process specific. Please refer to accompanying documentation for Dirty Window Sensor use.**

Figure 9-1 Window Contamination Examples



Window with Little to no Damage
(Acceptable for many Processes)

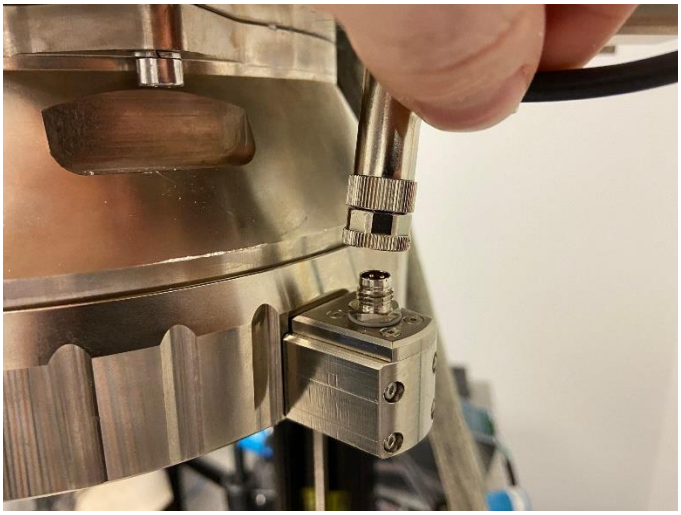
Window with Extensive Damage
(Needs Replacement Immediately)

9.3.1 2D High-Power Scanner Window Replacement Procedure

To replace the protective window in the 2D High-Power Scanner Window Assembly, please refer to the following procedure:

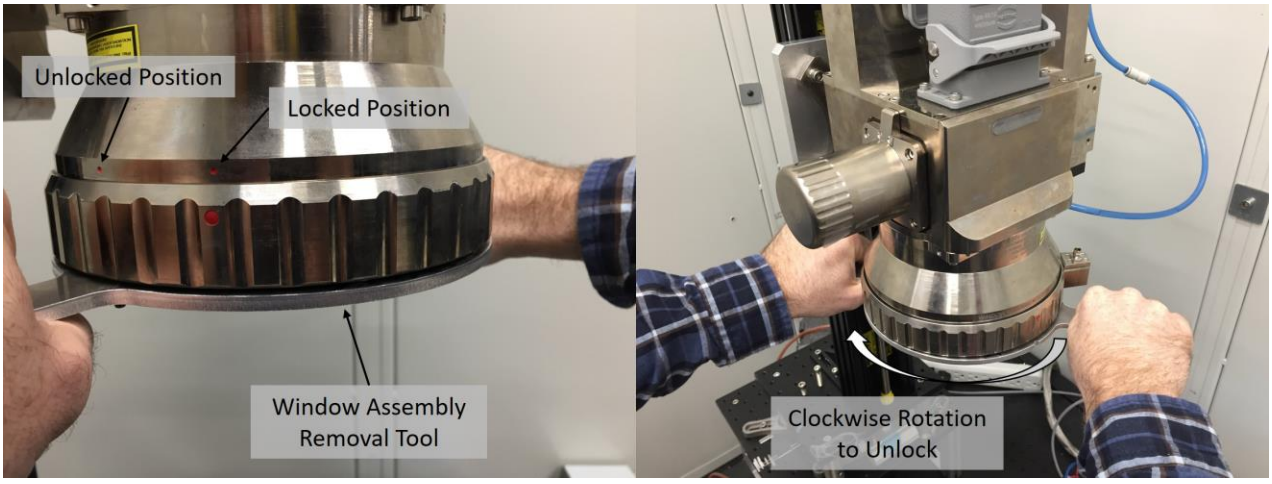
1. If using a scanner that has a Dirty Window Sensor (DWS), unscrew and disconnect the DWS cable from the Window Assembly. See Figure 9-2.

Figure 9-2 - Unplugging the Dirty Window Sensor



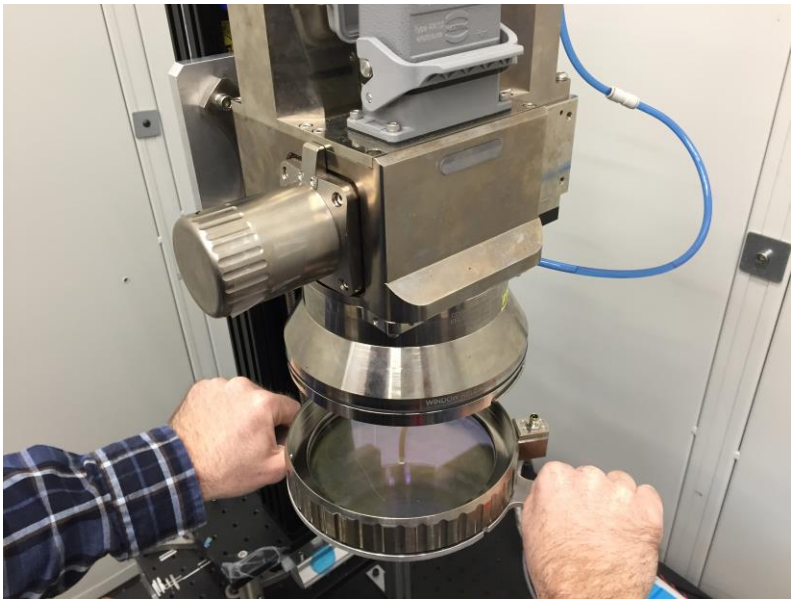
2. Rotate the Window Assembly on the scan head clockwise (if looking at the front of the scanner) to remove it from the focus lens assembly.
    a. Window Assemblies that include the Dirty Window Sensor have dowel slots in which a Window Assembly Removal tool can be utilized to easily rotate the Window Assembly (See Figure 9-3).
    b. Window Assemblies that do not include the Dirty Window Sensor do not have dowel slots in which a Window Assembly Removal tool can be used to rotate the Window Assembly. A strap wrench (McMaster Part Number: 54325A63) can be utilized to more easily remove the Window Assembly if necessary.

Figure 9-3 Unlocking the Window Assembly



3. With the Window Assembly unlocked and rotated clockwise, the Window Assembly will drop off the lens assembly (see Figure 9-4).

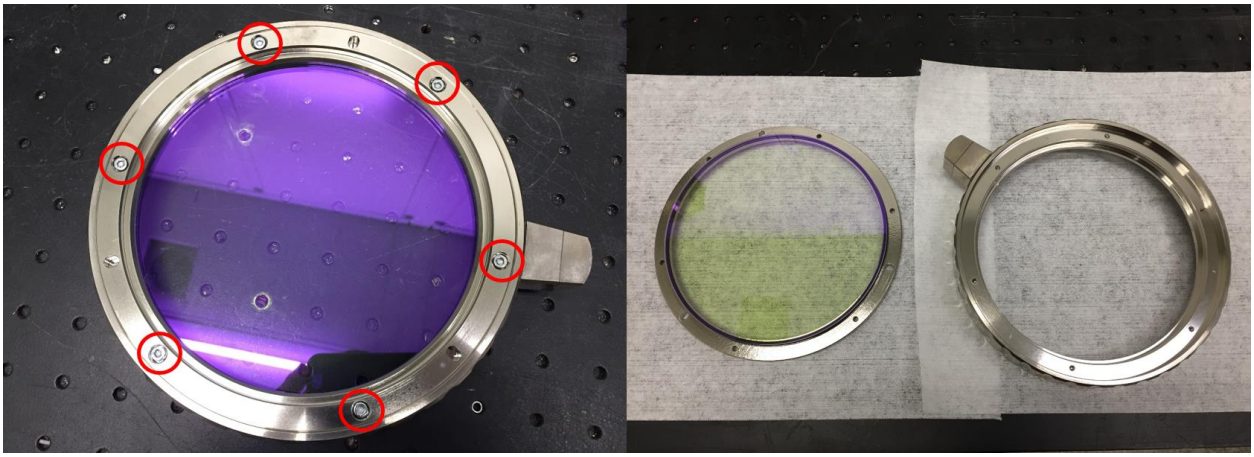
Figure 9-4 Removing the Window Assembly



WARNING: It is recommended that users have a spare Window Assembly on-hand in order to decrease the amount of time required to change out protective windows. The longer the lens is left exposed to the open environment, the greater the chance that the lens can become contaminated. Having a spare Window Assembly will help to reduce this exposure and also decrease cell downtime due to protective window change-out.

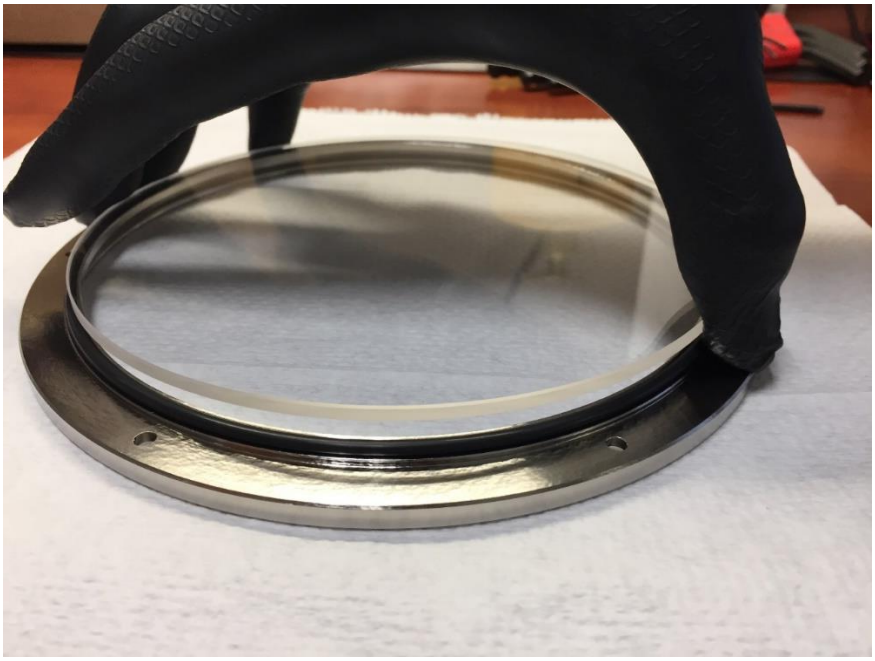
4. With the Window Assembly in a clean environment, use a 2.5mm hex driver to remove the screws to release the protective window retaining ring and protective window. See Figure 9-5.

Figure 9-5 Removing the Window Retaining Ring and Protective Window



5. Insert the replacement protective window glass into the frame. Be sure that the sealing O-rings are properly seated prior to placing the protective window glass. See Figure 9-6.

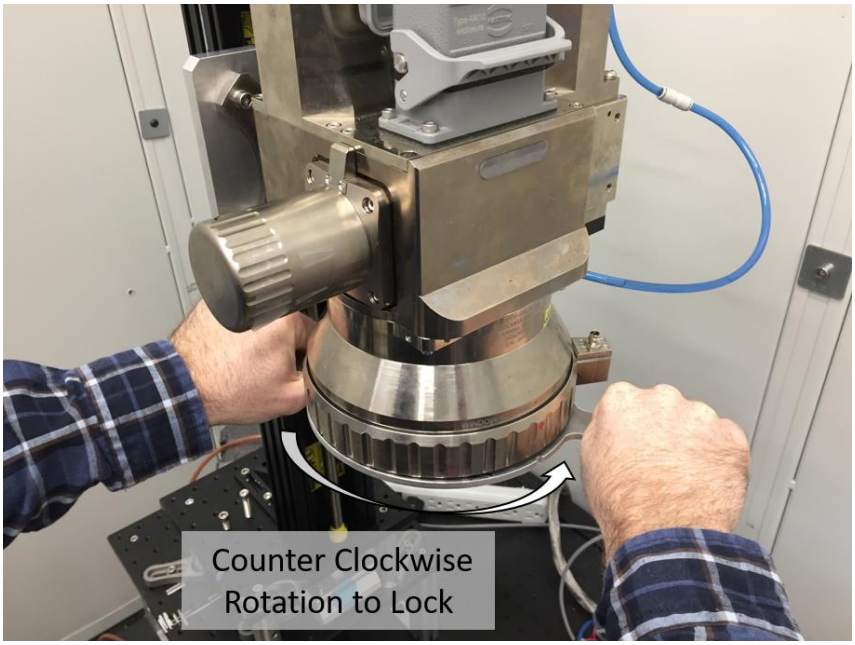
Figure 9-6 Replacing the Protective Window



IMPORTANT **Users should wear Latex or Nitrile gloves when replacing the protective windows to help prevent introducing contamination during the process.**

6. Replace the retaining ring and fasten the screws back into the frame.
7. Replace the Window Assembly by aligning the pins and grooves and rotating it counter clockwise (if looking at the front of the scanner). Observe the markings on the High-Power lens assembly for proper alignment, as shown in Figure 9-7.

Figure 9-7 Locking the Window Assembly



8. If using a scanner that has a Dirty Window Sensor (DWS), reconnect the DWS cable to the Window Assembly.

9.3.2 Mid-Power Scanner Window Replacement Procedure

To replace the protective window in the Mid-Power Scanner Window Assembly, please refer to the following procedure:

1. Rotate the Window Assembly on the scan head clockwise (if looking at the front of the scanner) to remove it from the focus lens assembly.
2. With the Window Assembly unlocked and rotated counter clockwise; the Window Assembly will drop off the lens assembly (see Figure 9-8).

Figure 9-8 Mid-Power Scanner Window Assembly Removal

3. With the Window Assembly in a clean environment, use a 2.5mm hex driver to remove the screws to release the protective window retaining ring and protective window.
4. Insert the replacement protective window glass into the frame. Be sure that the sealing O-rings are properly seated.
5. Replace the retaining ring and fasten the screws back into the frame.
6. Replace the Window Assembly by aligning the pins and grooves and rotating it counter clockwise.

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: Please inquire with IPG Service for approximate lead-time on the following items.**

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
Window Assembly (For CDSH0007… Series Scanners)	CDSBOM000008XXXU	1-2 (dependent on number of systems)
Window Assembly with Dirty Window Sensor (For CDSH0009… and CDSH0010… Series Scanners)	CDSBOM000093LDXU	1-2 (dependent on number of systems)
Window O-Ring (For CDSH0007… Series Scanners)	CMMIXXX1002305PX	1-2 per head
Window O-Ring (For CDSH0009… and CDSH0010… Series Scanners)	CMORORI0000034PX	1-2 per head
Window (Coverslide)	COPWXXXXXXXX032U	4-5 per head
Protective Window Cover	P45-017834	1 per head
3m Control Cable (Standard)	CEU00001089XXXXU	1 of the proper length
3m Control Cable (FLEX)	CEKBASY0000093PX	
5m Control Cable (Standard)	CEU00001865XXXXU	
5m Control Cable (FLEX)	CEKBASY0000094PX	
10m Control Cable (FLEX)	CEKBASY0000045PX	
Motion Interface Board	CMUS1001478XXXXU	1 (choose the board specific to your application)
Extended I/O Interface	CDSBEM000017XXXU	
24V Interface	CDSBEM000001XXXU	

9.4.2 Mid-Power Scanner

Table 9-2 outlines maintenance and spare parts for the 2D Mid-Power Scanner.

Table 9-2 Mid-Power Scanner Maintenance and Spare Parts

P30-010226 Mid-Power Scanner		
Description	**Part Number**	**Recommended On Hand Quantity**
Window – F100 & F163	COPWXEXXXXXX001U	2-3 per head
Window – F254	COPWXEXXXXXX002U	2-3 per head
Window – F330	COLFXXX0000038PX	2-3 per head
Window – F420	COLFXXX3000013PX	2-3 per head
Window – F160 & F254 (Fused Silica)	COPWXEXXXXXX020U	2-3 per head
Window Assembly - F160 & F254 (Fused Silica)	CDSBOM000199XXXU	1 per head
Window O-Ring (Fused Silica Window Assembly)	P40-019017	1-2 per head
3m Control Cable (Standard)	Contact IPG	1 of the proper length
3m Control Cable (FLEX)	Contact IPG	
5m Control Cable (Standard)	CEU00433488XXXXX	
5m Control Cable (FLEX)	Contact IPG	
Motion Interface Board	CMUS1001478XXXXU	1 (choose the board specific to your application)
Extended I/O Interface	CDSBEM000017XXXU	
24V Interface	CDSBEM000001XXXU	
P30-010300 Mid-Power Scanner with Collimator Input		
Description	**Part Number**	**Recommended On Hand Quantity**
Window – F100 &F163	COPWXEXXXXXX001U	2-3 per head
Window – F254	COPWXEXXXXXX002U	2-3 per head
Window – F330	COLFXXX0000038PX	2-3 per head
Window – F420	COLFXXX3000013PX	2-3 per head
Window – F160 & F254 (Fused Silica)	COPWXEXXXXXX020U	2-3 per head
Window Assembly - F160 & F254 (Fused Silica)	CDSBOM000199XXXU	1 per head
Window O-Ring (Fused Silica Window Assembly)	P40-019017	1-2 per head
3m Control Cable (Standard)	Contact IPG	1 of the proper length
3m Control Cable (FLEX)	Contact IPG	
5m Control Cable (Standard)	CEU00433488XXXXX	
5m Control Cable (FLEX)	Contact IPG	
Motion Interface Board	CMUS1001478XXXXU	1 (choose the board specific to your application)
Extended I/O Interface	CDSBEM000017XXXU	
24V Interface	CDSBEM000001XXXU	

IMPORTANT **Users should always base on-hand quantities of spare heads, parts, and consumables on their application, process, and production requirement needs.**

10 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 knife, 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(s)
- 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 10-1, 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 Systems

Item	Description	Supplier
Scanner Equipment		
Scanner & Scan Controller	3D / 2D High-Power Scanner / Mid-Power Scanner	IPG Photonics
Air Knife (Cover Slide Protection)	For protecting coverslides during processing	IPG Photonics
Air Knife (Plume Suppression)	Aids with process control/stability. Often mounted to fixturing.	IPG and Non-IPG Suppliers
24V Power Supplies	For power to the scanner, Scan Controller, and laser outputs	Non-IPG Suppliers
Mounting Adapters (Scanner and Scan 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	See individual application examples for required quantities.	Non-IPG Suppliers
24V Interface or Extended IO Interface	Typically used with PLC/Robotic communication applications	IPG Photonics
Motion Interface	Typically used with motor driver and/or encoder applications	IPG Photonics
***Cables/Connectors**		
Power	For providing power to the scanner and Scan Controller.	Customer supplied (connectors are included)
Control Cable	Supports communication between the scanner and Scan Controller. 3m, 5m, and 10m, versions are available.	IPG Photonics
Scan Controller to Laser Interface Cable	Supports communication between the Scan Controller and laser.	Customer supplied. (laser connectors come with laser)
Ethernet Cable	Supports communication between the computer running IPGScan and the Scan Controller.	Non-IPG Suppliers
External Interface Cables	Supports communication between the Scan Controller and External Control Interface	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 External Interface)

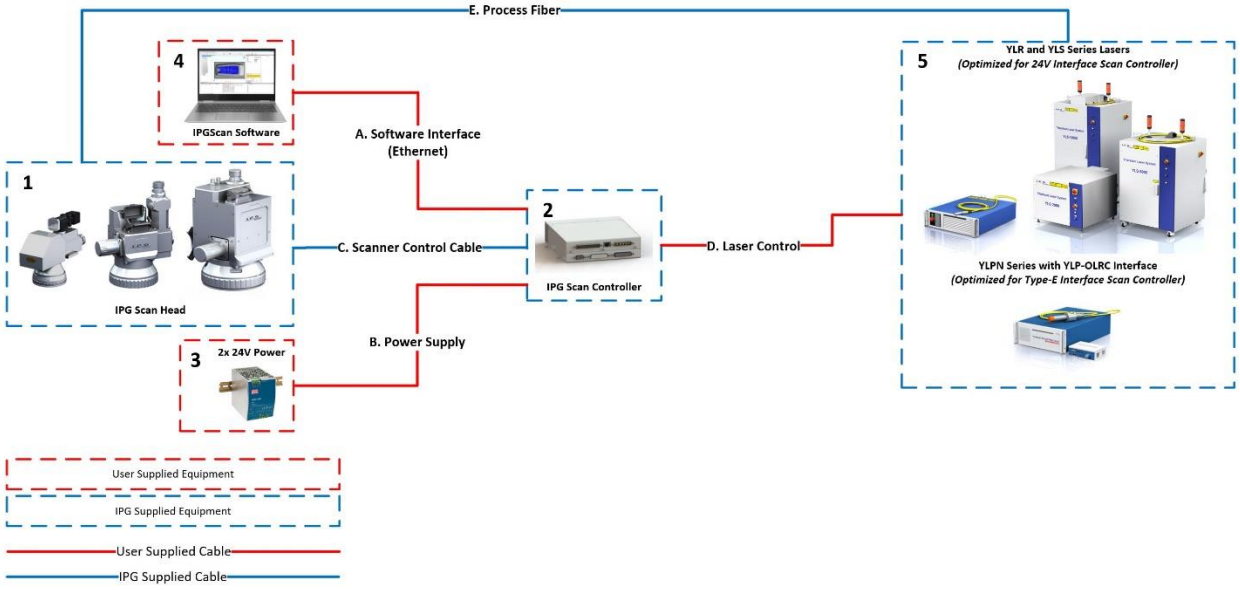
Although this is not as frequently encountered as Point and Shoot processing, a standalone scanning system is sometimes desired. One such application that users may want a standalone system is for research and development. With this type of setup, the user is limited to running the scanner though a computer. 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

10.3.1.1 Standalone Scanning System Example

- Equipment:
    1. Scanner
    2. Scan Controller
    3. 24V Power Supplies
    4. Computer
    5. Laser
- Cables
    A. Computer to Scan Controller
    B. 24V Power Supplies to Scan Controller
        - Should not exceed 15ft with 16 AWG
    C. Scan Controller to Scanner
        - 3m, 5m, or 10m Options Available
    D. Scan Controller to Laser
    E. Process Fiber

Figure 10-1 Standalone Scanning System Example Diagram



IMPORTANT **Be sure to check the water cooling requirements for the giving application.**

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 doorframes, seat components, and anything in need of coating removal.

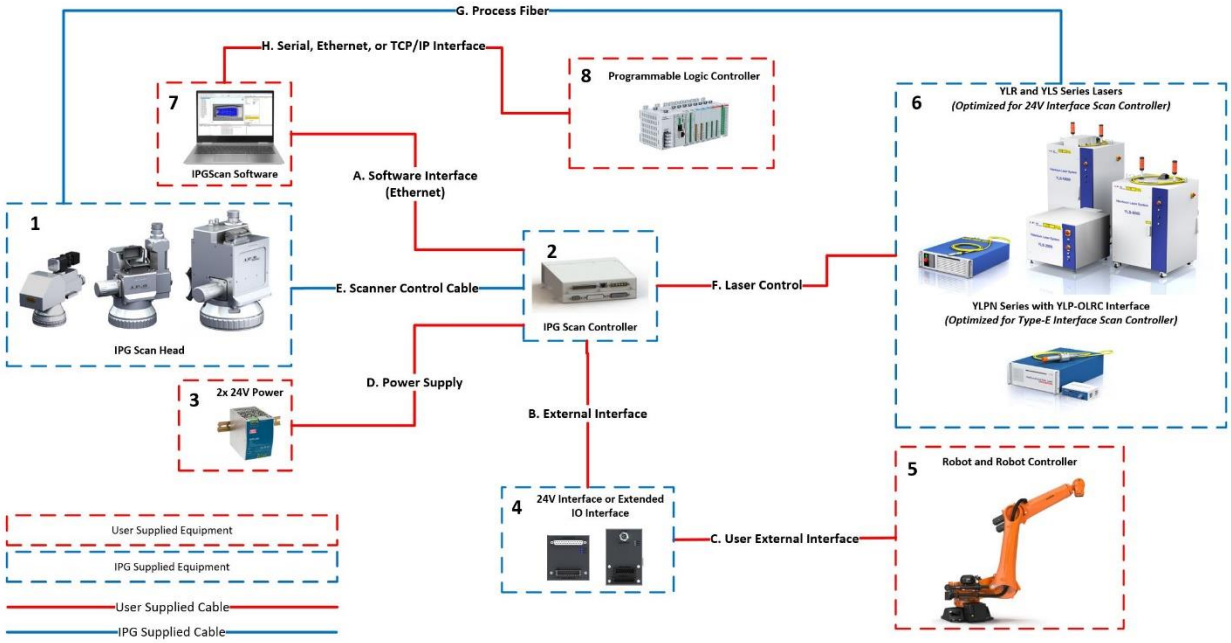
The following sections provide example layouts, process requirements for both hardware and interfacing, and any additional information that may pertain to the process.

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 Supplies
    4. 24V Robot Interface or Extended IO 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 or Extended IO Interface to Scan Controller
    C. 24V Interface or Extended IO Interface to Discrete Digital IO
    D. 24V Power Supplies to Scan Controller
        - Should not exceed 15ft with 16 AWG
    E. Scan Controller to Scanner
        - 3m, 5m, or 10m Options Available
    F. Scan Controller to Laser
    G. Process Fiber
    H. PLC to Computer Ethernet/Serial Cable (Optional)

Figure 10-2 Robotic Scanning System Example Diagram



IMPORTANT **Be sure to check the water cooling requirements for the giving application.**

10.4.1.2 Hardware

In addition to the outlined items in Table 10-1, Table 10-2 outlines the required number of Robot or PLC I/O given the proper External Control Interface.

Table 10-2 Required Hardware - Point and Shoot Processing

Item	Description
24V Digital Outputs	24V Interface: 12 outputs are required Extended IO Interface: 12 outputs are required, 19 can be used
24V Digital Inputs	24V Interface: 3 inputs are required, 4 inputs can be used Extended IO Interface: 3 inputs are required, 16 can be used
24V Interface or Extended IO Interface	Interface between robot signals and scanner signals. Cables between the robot I/O, external interface board, and the Scan Controller are supplied by the customer.

10.4.1.3 Point and Shoot Programming

Please refer to the IPGScan Software User Guide 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 with the continued demand to decrease process cycle time.

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 system diagram in section 10.4.1.1 for a system layout. The only additional connection for Robotic On-The-Fly processing is an Ethernet connection from the robot controller to the computer running IPGScan. This connection is for capturing robot trajectory information.

10.5.1.2 Hardware

In addition to the outlined items in Table 10-1, Table 10-3 outlines the minimum required number of Robot I/O given the proper External Control Interface.

Table 10-3 Required Hardware - Robotic On-The-Fly Processing

Item	Description
24V Digital Outputs	24V Interface: 2 outputs are required Extended IO Interface: 2 outputs are required
24V Digital Inputs	24V Interface: 3 inputs are required, 4 inputs can be used Extended IO Interface: 3 inputs are required, 16 can be used
24V Interface or Extended IO Interface	Interface between robot signals and scanner signals. Cables between the robot I/O, external interface board, and the 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 OR EXTENDED IO INTERFACE BOARD. IT SHOULD BE A DIRECT DISCRETEE IO CONNECTION FOR CONSISTENT PROCESSS 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 for the 24V interface or 19 digital outputs and 16 digital inputs with the Extended IO Interface 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 Software User Guide for additional information on scanner programming, additional robot requirements, and setup.

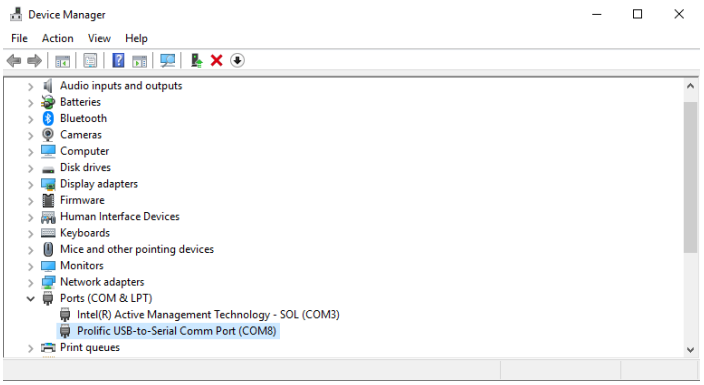
Appendix

A Resetting a Scan Controller IP Address through Serial

The following steps detail how to reset the IP Address of a Scan Controller using the serial port.

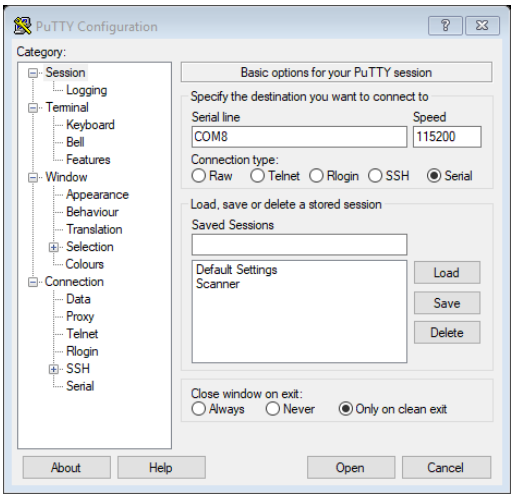
1. Connect a computer to the Scan Controllers RS232 port using a USB to RS232 cable
2. Determine which COM Port is the connection to the Scan Controller
    a. This can be determined by opening the Device Manager
    b. The following example (Figure A-1) shows that COM8 is the connection to the Scan Controller.

Figure A-1 Finding the COM# in Device Manager



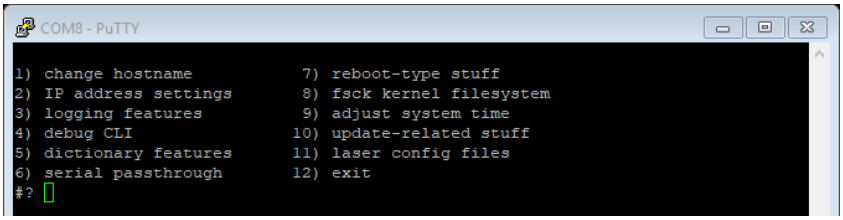
3. Open a Serial Terminal
    a. This set of instructions utilizes PuTTY for the terminal.
4. Set the connection type to “Serial”
5. Set “Serial line” to the proper COM Port value
6. Set “Speed” to 115200
    a. The following image (Figure A-2) details steps 2-5.

Figure A-2 Serial Setup using PuTTY



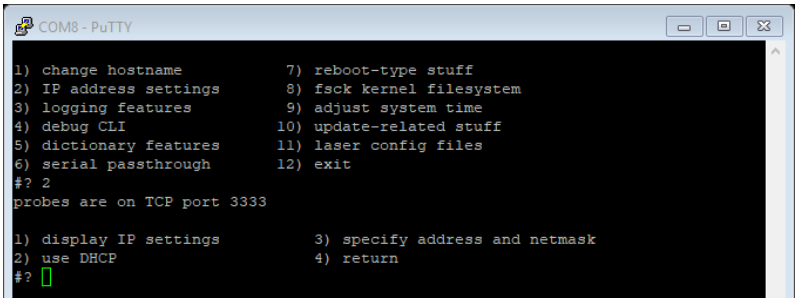
7. Click “Open”
    a. A command terminal will then open
8. Hit enter in the command terminal to display a list of commands (Figure A-3)

Figure A-3 List of Available Commands



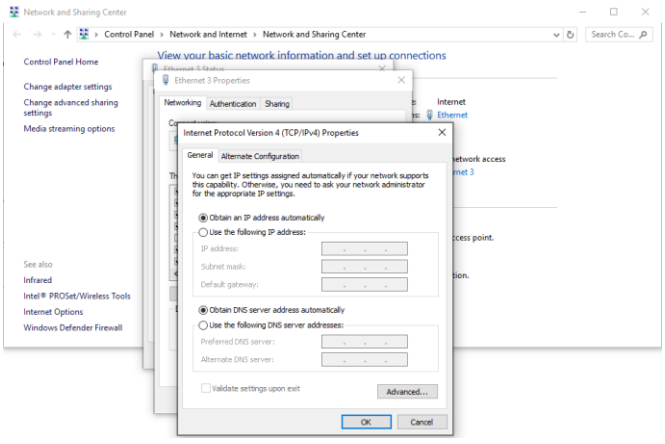
9. Type 2 and hit enter to display a list of commands for IP address settings (Figure A-4)

Figure A-4 IP Address Setting Commands



10. Type 2 and hit enter to set the Scan Controller back to DHCP
    a. Please be patient as the Scan Controller reboots. The user will see data stream in the command terminal as the Scan Controller reboots. This process can take up to 5 minutes.
11. Once the Scan Controller has rebooted, set the appropriate local area connection for the Scanner back to “Obtain an IP address automatically” (Figure A-5)

Figure A-5 Setting the Network Connection



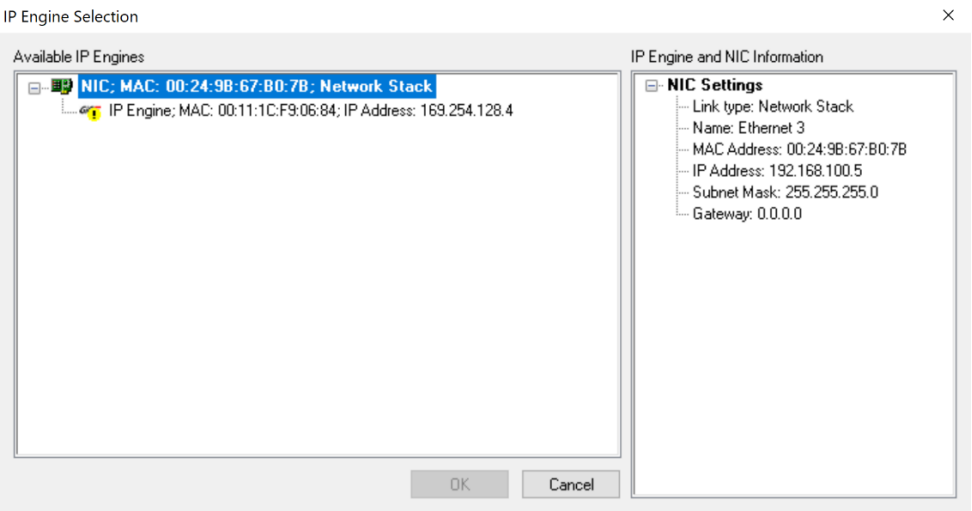
12. It should now be possible to reconnect to the Scan Controller in the Scan Controller Utility or IPGScan

B Sentech Ethernet Camera Firmware Update

Upon receiving the Sentech Ethernet camera, users should update the firmware. The following procedure outlines how to update the firmware.

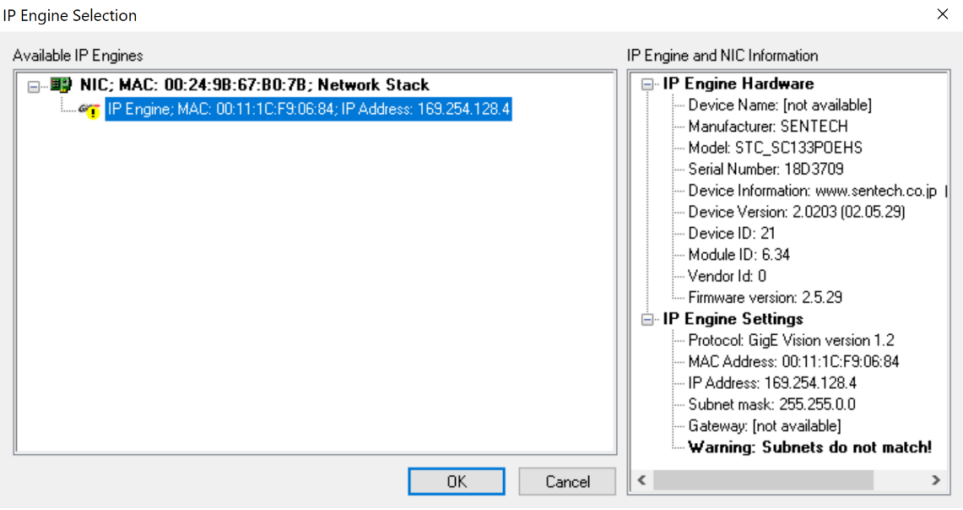
1. Connect the camera to a computer using an Ethernet cable.
    a. The camera should be directly connected to the computer. While it is ok to use a USB to Ethernet adapter for this connection, the camera should not be put on a network. High network traffic can interrupt the connection with the camera.
2. Power the camera on using the supplied power supply.
3. Launch the application "STC-SC133POEHS-DeviceVersion2.0201-HardwareVersion4." The window pictured in Figure B-1 should appear.

Figure B-1 Sentech Firmware Launch Window



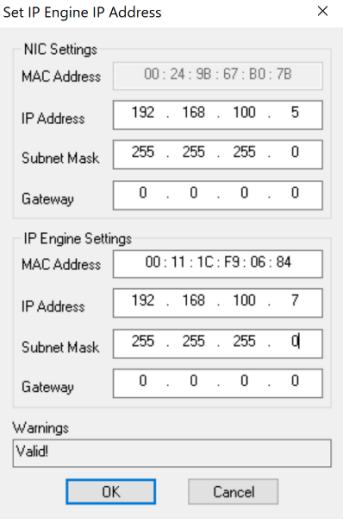
4. Select the listed camera. Under "IP Engine and NIC Information," the camera's information will be listed. See Figure B-2.

Figure B-2 Selecting the Camera for Update



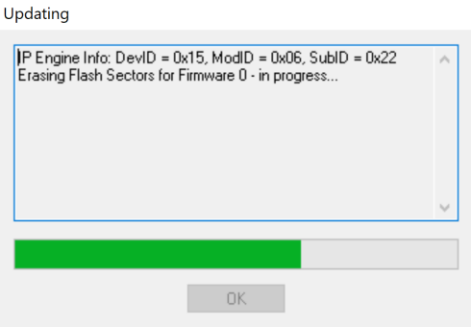
5. Click “OK.”
    a. Note that if an IP address conflict exists, users will be prompted to change the camera’s IP address prior to the update taking place. Under the “IP Engine Settings” box, users can set an IP address for the camera that is similar to the computers adapter settings. When a valid IP address is set, the user should see “Valid!” under the “Warnings” box. See Figure B-3. Click “OK” to close the IP address window.

Figure B-3 Setting the Camera's IP Address



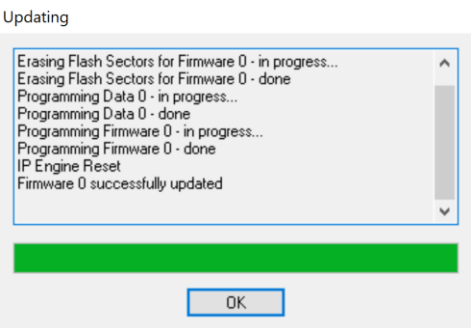
6. Click “OK” to start the update process and wait for the firmware update to complete. This could take multiple minutes. See Figure B-4.

Figure B-4 Update in Progress



7. Once the update is complete, click “OK.” See Figure B-5.

Figure B-5 Update Complete



8. Power down the camera for a minimum of 30 seconds. Please note, the next time the camera is powered up, the IP address may need to be reset according to the users adapter settings.

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C Product Returns

C.1 Returns to the United States

All product returns require a Return Merchandise Authorization (RMA) from IPG.

To obtain an RMA, call the Customer Service department of IPG Photonics Corporation at 508-373-1100 (US) or +49 2736 44 20 451 (Germany).

If you return a product with a RMA, please 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 IPG.
2. Buyer must issue a purchase order for the value of the replaced parts/service items and IPG will issue credit or invoice when the parts/service is received. Speak to IPG Service Manager for the amount authorized under the required purchase order.
3. All requests for repair or replacement under this warranty must be made to IPG within 30 days after discovery of the defect (but not later than 7 days after warranty expiration).
4. All products returned to IPG but which meet applicable specifications, not defectively manufactured or used not in accordance with this User's Guide, will result in the Buyer being charged IPG'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.

C.1.1 Shipping Instructions

Warranty Returns

Domestic & International Buyers* pay for one-way freight costs and insurance to IPG. IPG will pay for freight return cost and insurance back to the Buyer.

Non-Warranty Returns

Domestic & International Buyers* pay for two-way freight costs and insurance to IPG. If shipment consists of returns that are both warranty and non-warranty, the shipment will be considered as non-warranty.

Shipping address for returns to US:

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

IMPORTANT **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 thirdparty 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