Laser Marking Module Series User Guide

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Preface

Ensure you read and understand this guide in its entirety and familiarize yourself with the operating and maintenance instructions before you use the product. IPG strongly recommends that all operators of the product read and pay particular attention to all safety information contained herein prior to operating the product.

This guide should stay with the product to provide you and all future operators, users, and owners of the product with important operating, safety, and other information.

For technical assistance concerning the product, contact IPG Customer Service.

Audience

The audience for this guide are system integrators and technicians responsible for installing and operating the Laser Marking Module in industrial and non-industrial installations.

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Overview

Introduction

The Laser Marking Module consists of a new generation pulsed fiber laser, which is fully integrated with a two-axis scanning system. High-pulse energy of the YLP-Series laser combined with the fast and accurate positioning of the scanning sub-module provide high-marking speeds.

The Laser Marking Module also includes control electronics and scanning optics. This complete module comes fully optimized, pre-calibrated, and designed to help integrators enhance their laser marking products.

The Laser Marking Module also lets you use industry standard command inputs for use with your own scan controller and marking software.

There are two versions of the Laser Marker Module covered in this guide:

- Laser Marker Module XY2-100
- Laser Marker Module with Integrated Scan Controller

Additional Documentation

Refer to the following documentation included with the product:

- *Specification Ytterbium Pulsed Fiber Laser - YLP-V2 1mJ series*
- *YLP-Series Pulsed Fiber Laser User Guide*

Applications - Industrial and General Manufacturing

Varieties of Materials: Stainless Steel, Aluminum, Brass, Nickel Alloy, Silver and many others.

Key Terms

- **Laser Source** — responsible for generating the laser beam.
- **Scan Head** —deflects a laser beam using galvo-controlled mirrors through a scanning lens.
- **Laser Marking** — delivers and focuses a laser beam on a target surface.

Certification

IPG certifies that the Laser Marking Module is thoroughly tested and inspected, and meets 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. For use as a system component only. It is the responsibility of the purchaser/end-user to bring the end system into full compliance with all applicable regulations.

Recommended Requirements

IPG Photonics recommends the following additional requirements for your Laser Marker system:

- Safety Switch
- Z Stage Positioner to hold Optical Scanner Head
- Fume Extraction System to remove gases and particles released during the laser marking process.

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 to 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 Symbols

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

EMC Compliance

The YLP-Series lasers are components and should be integrated into finished system. The EMC (CE mark relevant) standards are not applicable to the laser modules, however 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 possibility to build a CE compliant laser system with an integrated YLP-series laser module.

Laser Classification

This device is classified as a high power Class IV laser product under 21 CFR 1040.10. This product emits invisible laser radiation at or around a wavelength of 1062 nm, and the total light energy radiated from the optical output is up to 110W Average. This level of light can cause damage to the eye and skin. Despite the radiation being invisible, the beam can cause irreversible damage to the cornea. Laser safety eyewear is not provided with this product, but must be worn at all times while the laser is operational.

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 module. It can emit up to 1mW average power near 660nm wavelength and is classified as class 2m visible laser radiation in terms of IEC 60825-1:2007. Avoid direct eye exposure.

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

Safety Label Locations

Figure 1-1 shows the required laser safety labels and the locations on the device. These include warning labels indicating removable or displaceable protective housings, apertures through which laser radiation is emitted and labels of certification and identification.

Figure 1-1. Safety Label Locations — Laser Marker Module

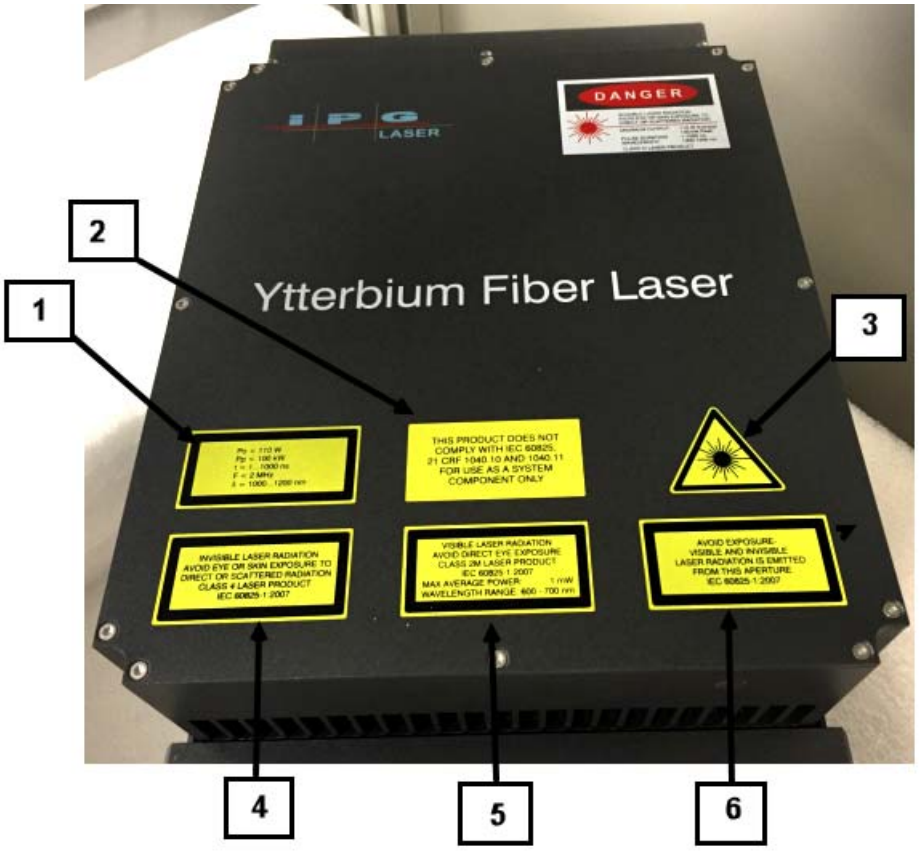


Figure 1-2. Safety Label Locations — Optical Scanner Head

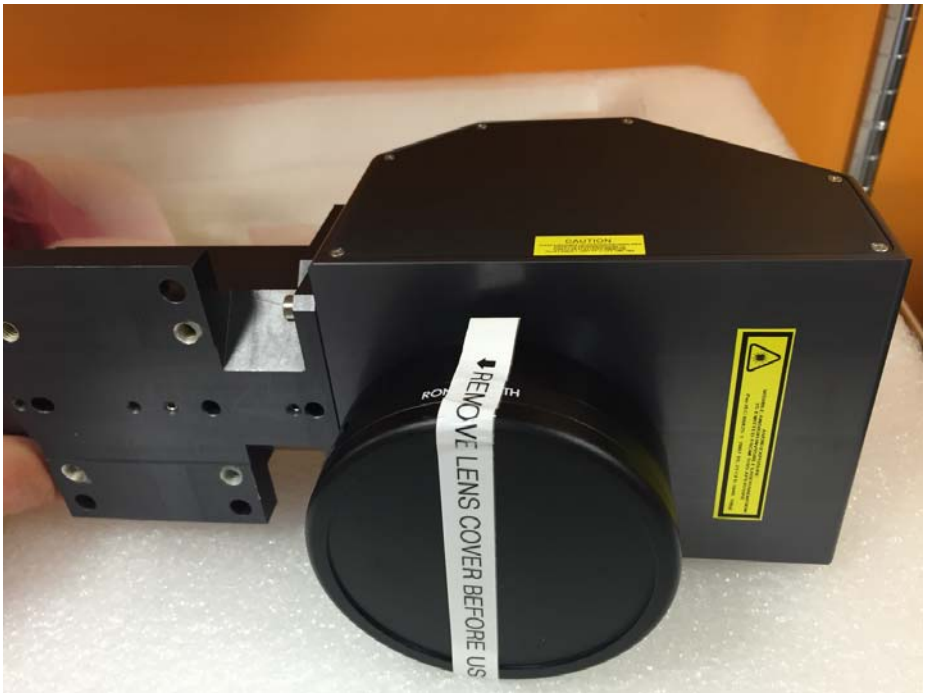
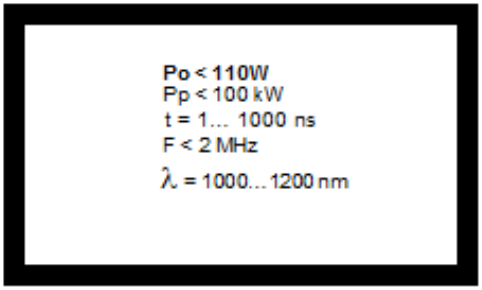
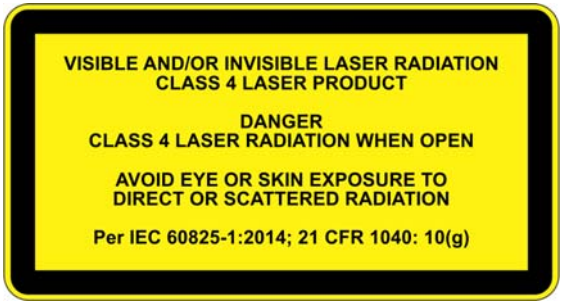
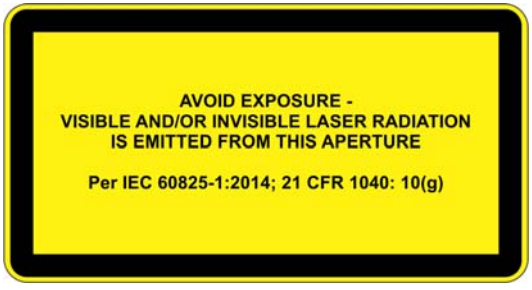
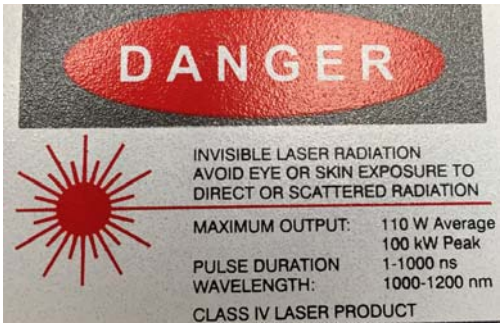
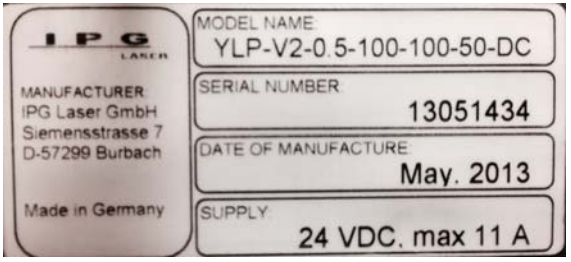


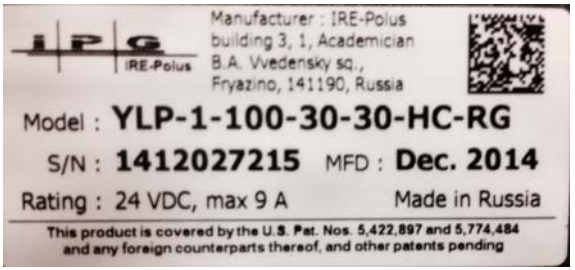
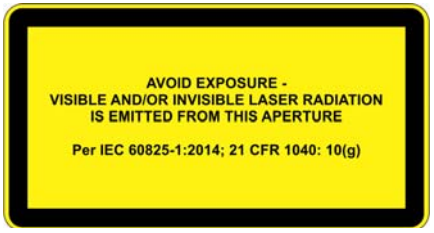
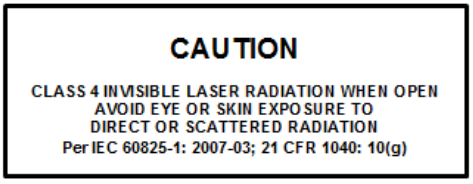
Table 1-2 on page 1-7 provides the safety label descriptions.

Table 1-2. Safety Label Descriptions

Item	Label Name	Description
1	Optical Properties Po is average power. Pp is peak power.	
2	Certification Label	THIS PRODUCT DOES NOT COMPLY WITH IEC 60825, 21 CFR 1040.10 AND 1040.11 FOR USE AS A SYSTEM COMPONENT ONLY
3	Laser Radiation Hazard Label	

4	Class 4 Laser Product (Model YLP Series)	
5	Laser Product	
6	Aperture Label Location	

	Class 4 Laser Product (Model YLP Series)	
	Identification Plate (Products Made in the United States)	
	Identification Plate (Products Made in Germany)	

	Identification Plate (Products Made in Russia)	
	Optical Scanner Head Aperture Label	
	Optical Scanner Head Caution Label — Class 4	
	Warranty Void Sticker	

	Caution Label - consult accompanying documentation.	
	Functional Earth Label	

General Safety Instructions

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

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 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 the device.

Equipment and Solvents

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

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 the device.

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 power is on.

Do not stare into the beam of view directly with optical instruments.

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 laser. Exercise caution if debris is being generated in your application.

Do not exceed the maximum specified optical input for the Laser Marker Module.

Ensure all electrical and optical connections are connected to the correct locations. Ensure work cell electrical connections and workcell optical connections are matched properly.

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.

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 the 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.

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.

IPG provides the following recommendations to promote the long life of the Laser Marker Module:

- 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.

Safety Features

Fiber Interlock Loop

A Fiber Interlock Loop is connected between the laser module and the optical head. 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.

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 Electro-technical Commission
IEC 60825-1, Edition 2
Safety of laser products -
Part 1: Equipment classification, requirements and user's guide.
(Available through LIA)

Center for Devices and Radiological Health
21 CFR 1040.10 - Performance Standards for Light-Emitting Products
US Department of Labor - OSHA
Publication 8-1.7 - Guidelines for Laser Safety and Hazard Assessment

US Department of Labor - OSHA
Publication 8-1.7 - Guidelines for Laser Safety and Hazard Assessment

Laser Safety Equipment
Laurin Publishing
Laser safety equipment and Buyer's Guides

Note

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.

Using the Laser Marker Module

Overview

The Laser Marker Module consists of a laser device connected to a optical head by a flexible cord. Components are located in the base enclosure with the laser board, laser diodes, and optical scanner.

Figure 2-1 illustrates the Laser Marker Module, XY2-100 Version architecture.

Figure 2-1. Laser Marker Module Architecture

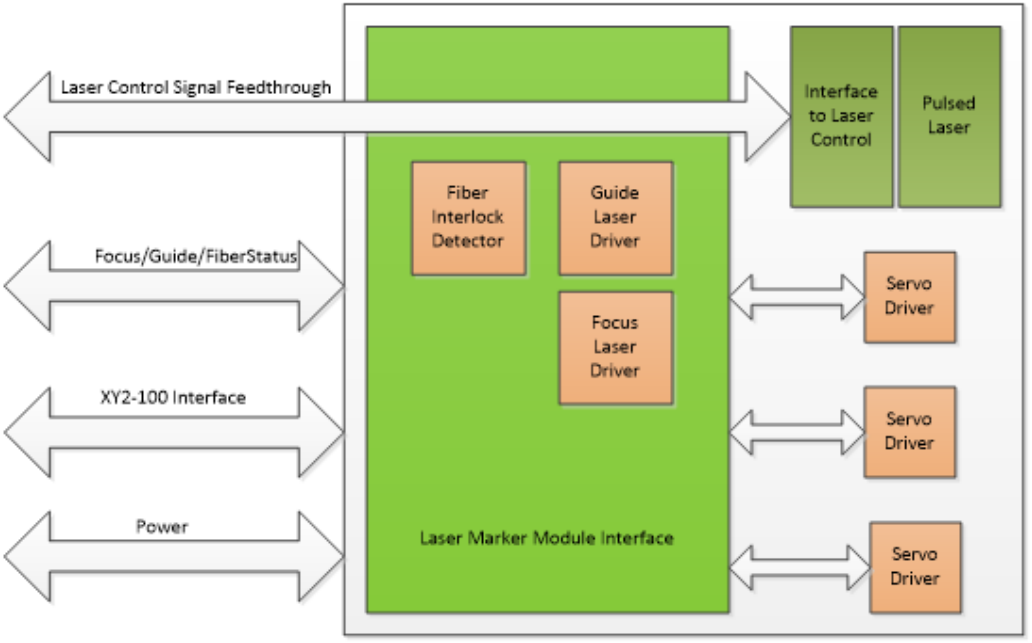
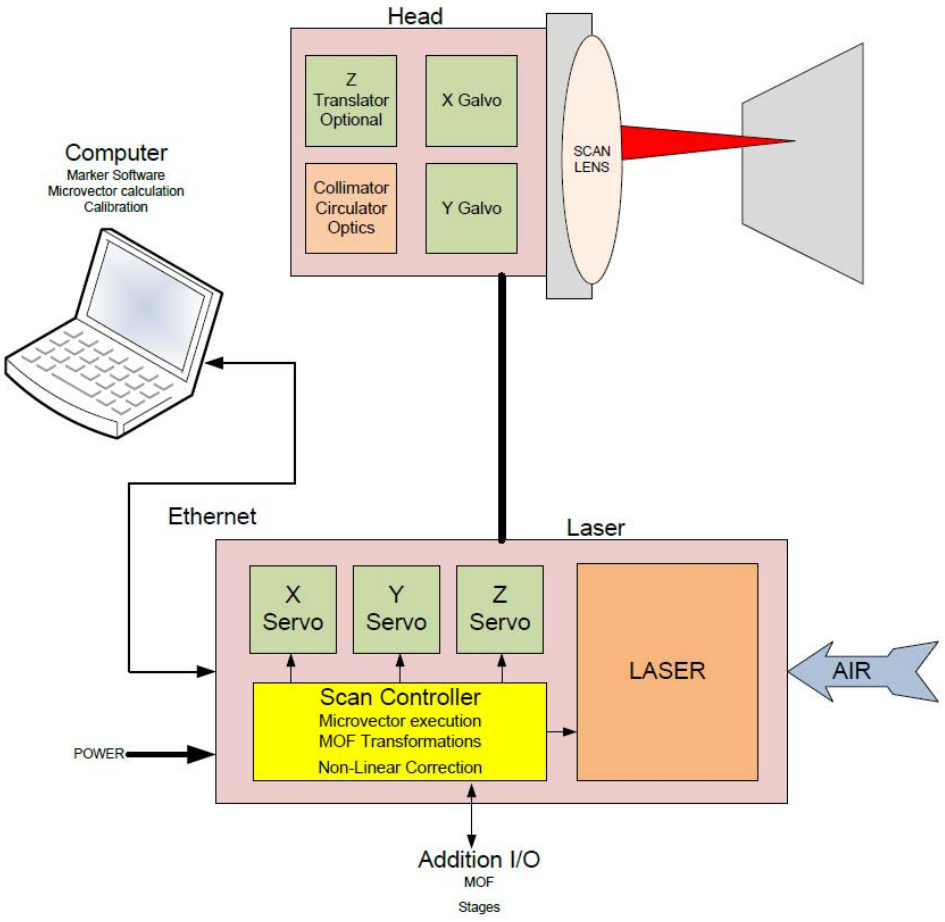


Figure 2-2 illustrates the Laser Marker Module with Integrated Scan Controller Version architecture.

Figure 2-2. Laser Marker Module Scan Controller Architecture



The Scan Controller interfaces between a software dll on a PC, servo drivers, stages, encoders, lasers, and any other external systems. When used with external stages, the Scan Controller can monitor the stage location and output the image objects when the correct workspace location is in view, or control external stages.

Specifications

Table 2-1 and Table 2-2 list the specifications for the Laser Marking Module and the Optical Scanner Head.

Table 2-1. Laser Marker Module Specifications

Average Output Power	**10W**	**20W**	**30W**	**50W**
Mode of Operation	Pulsed			
Polarization	Random			
Maximum Pulse Energy	1 mJ			
Nominal Average Output Power (in watts) Minimum Typical Maximum	 9.5 10 11	 19 20 21	 28 30 32	 47 50 53
Output Power Adjustment Range	10 - 100 %			
Nominal Power Adjustment Range	**10W**	**20W**	**30W**	**50W**
Pulse Duration $\Delta\tau$ Minimum Typical Maximum	 80 ns 100 ns 120 ns			
Central Emission Wavelength	1064 nm			
Pulse Repetition Rate	2 - 200 kHz			
Laser Switching On/Off Time	2 - 3 µs			

Table 2-2. Optical Scanner Head Specifications

Unit	Description
Clear Aperture	12 mm
Square Field Size Options	60 mm (100 mm working distance) 110 mm (163 mm working distance) 170 mm (254 mm working distance)
Tracking Delay	100 µsec
Protection Class (Process Unit)	IP67
Weight (Process Unit)	9 lbs.

Unpacking Instructions

Note

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

Particular care must be taken when you remove the unit from the shipping carton to ensure that the fiber optic cord is not broken or damaged.

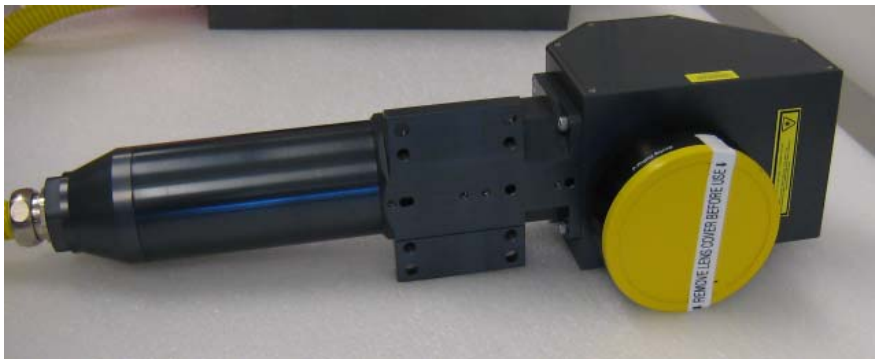
CAUTION: To minimize the risk of damage to the device, IPG Photonics recommends that you unpack your Laser Marker Module and Optical Scanner using the following procedure.

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 Laser Marker Module and Optical Scanner Head out of the box. The flexible yellow cord is already connected to the Optical Scanner Head. IPG strongly recommends two people to lift the unit to avoid damaging the fibers in the flexible yellow scanner cord.
4. Carefully place contents on a stable surface.
5. Remove the cover from the Optical Scanner Head before use. Store for later use if needed.
6. If you have the XY2-100 version, remove the USB memory stick and store it in safe place. Calibration files for third-part controllers are stored in the USB memory stick. See “Calibration Files (XY2-100 Version Only)” on page 2-12 for instructions.

Figure 2-3. Optical Scanner Head with Cover



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

Optical Scanner Head

The Optical Scanner Head connects to the optical outlet with a flexible yellow cord. The cord is connected prior to shipment.

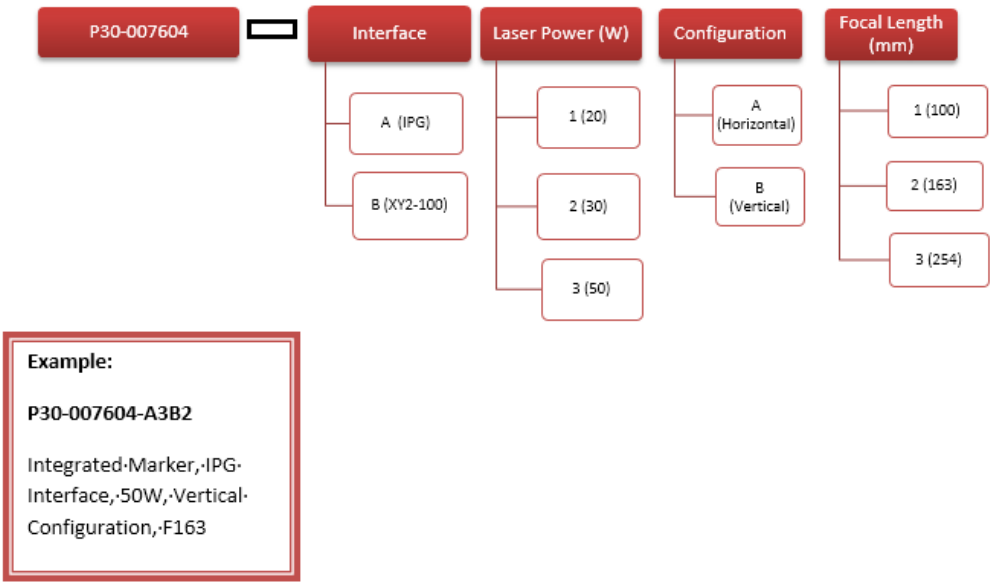
Figure 2-4. Optical Scanner Head

The Optical Scanner Head has the following features:

- 2D Factory Calibrated Marker
- 12mm CA Optics
- Optional Focus Laser
- IP67 Head Enclosure

Figure 2-5 illustrates the available configurations for the optical scanner head.

Figure 2-5. Optical Scanner Head Configurations



The Optical Scanner Head includes three lens options as listed in Table 2-3.

Table 2-3. Specifications for Three Lens Options

Item	Len 1	Lens 2	Lens 3
Focal Length (mm)	100	163	254
Spot Size @ 1/e2 (mm)	11	25	40
Working Distance (mm)	102	189	289
Field Size (mm)	60 x 60	110 x 110	170 x 170

Note Working distances are taken from the edge of the lens housing.

Bolt Pattern and Field Center

The bolt pattern and field center diagrams are shown in Figure 2-6 (horizontal configuration) and Figure 2-7 (vertical configuration).

Figure 2-6. Scanner Head Diagram - Horizontal Configuration

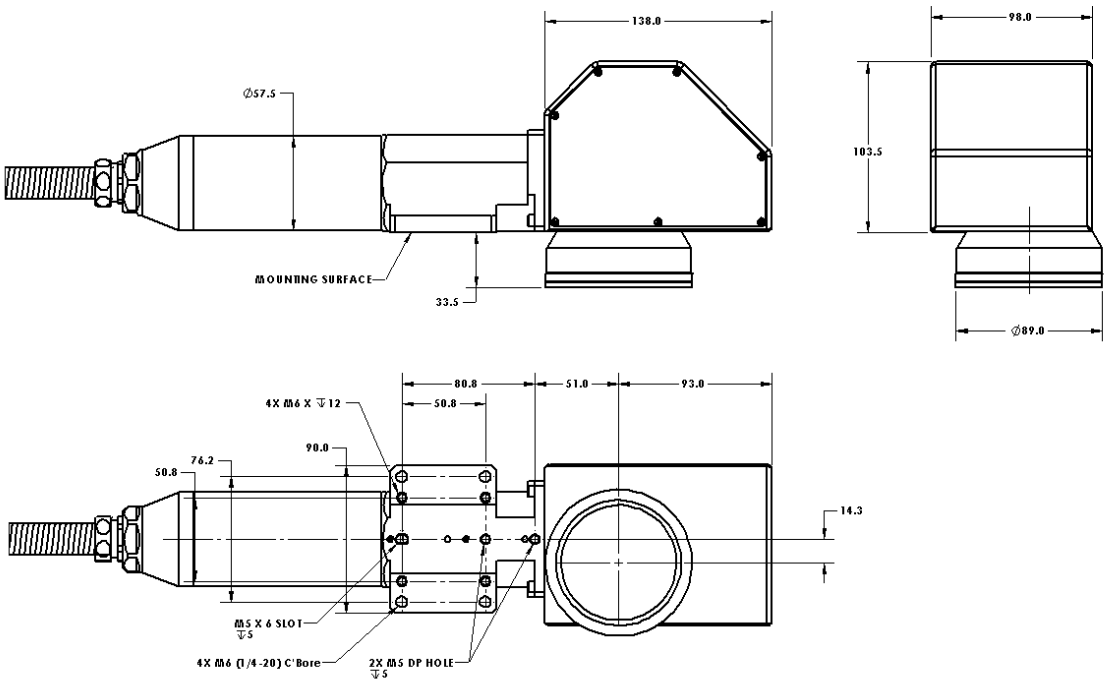
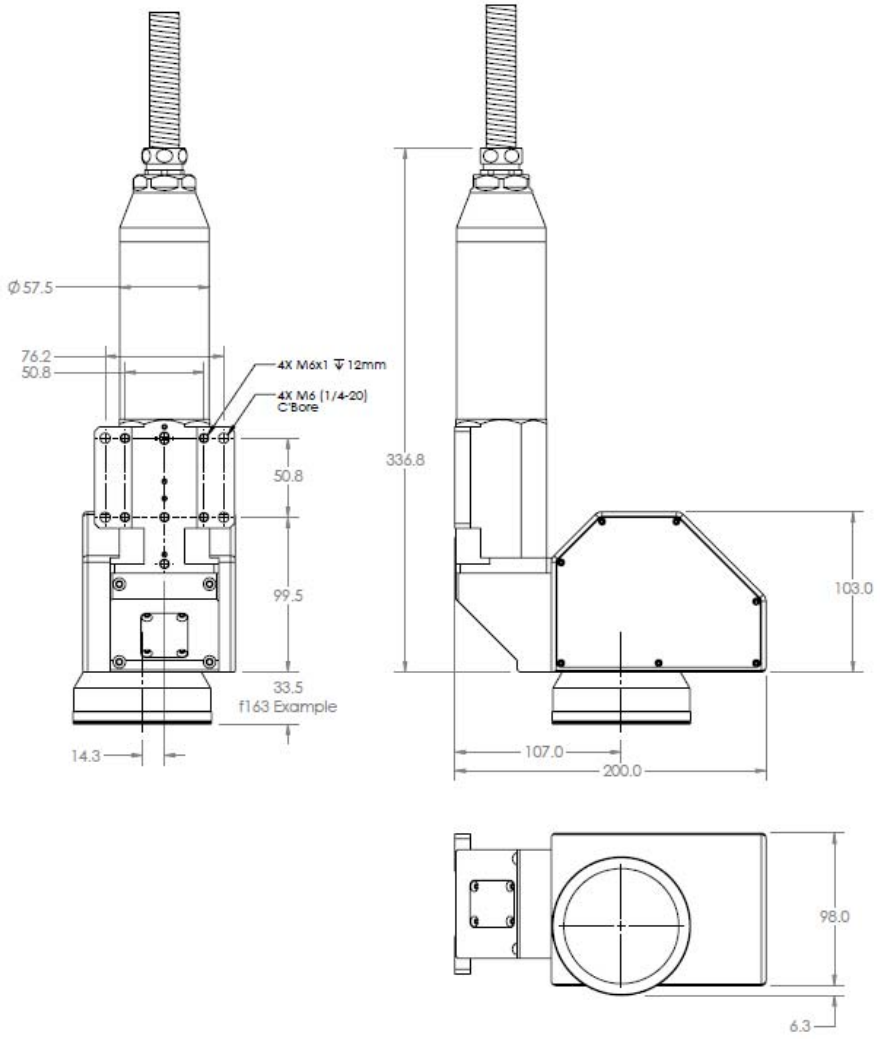


Figure 2-7. Scanner Head Diagram - Vertical Configuration



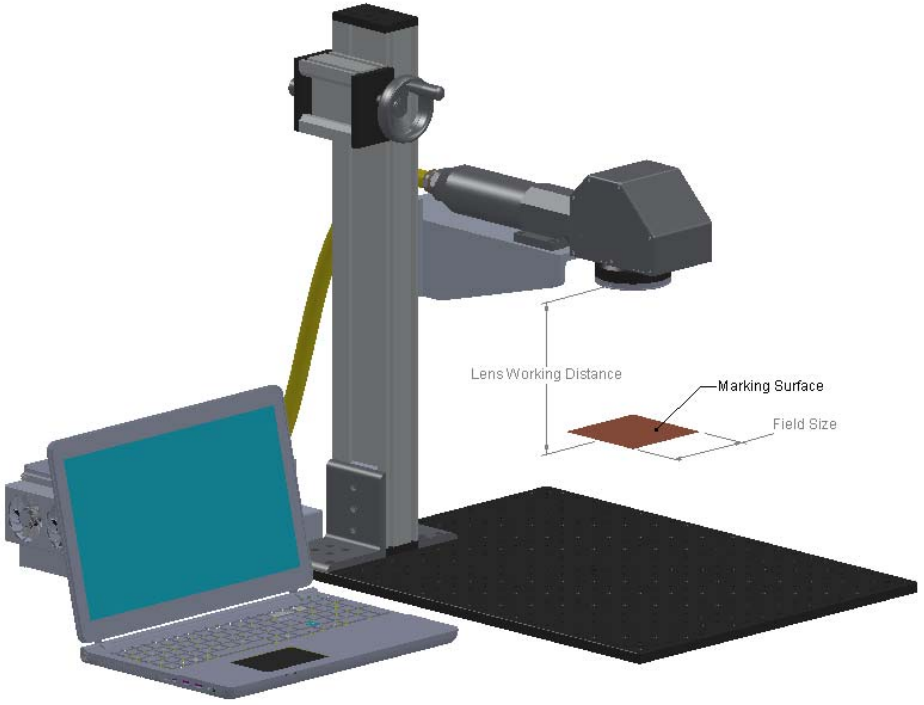
Mounting the Laser Marker Module

You can mount the Laser Marker Module to a base plate using the four holes in the housing. The output head should be clamped to the mounting surface.

Example of a Laser Marker Module Setup

Table 2-8 illustrates the Laser Marker Module bolted on a platform with the lens working distance, marking surface, and field size.

Figure 2-8. Laser Marker Module Setup



Connecting the Cables — Laser Marking Module: XY2-100 Version

IPG does not include cables in the shipment of the Laser Marker Module. You are responsible for providing your own cable connectors. Contact IPG Customer support if you need assistance.

See “Laser Marking Module: XY2-100 Version — Rear Panel View” on page 2-13 for details on the rear panel.

To connect the cables to the Laser Marker Module XY2-100:

1. Connect a 5-pin female cable to the 5-pin male Power Supply.
2. Connect a 25-pin female cable to the 25-pin male Laser Control interface.
3. Connect a 25-pin male cable to the 25-pin female XY2-100 interface.
4. Connect a 9-pin female cable to the 9-pin male RS-232 interface.

Connecting the Cables — Laser Marking Module: Integrated Scan Controller Version

See “Laser Marking Module: Integrated Scan Controller Version — Rear Panel View” on page 2-24 for details on the rear panel.

To connect the cables to the Laser Marker Module with the Integration Scan Controller:

1. Connect a 5-pin female cable to the 5-pin male Power Supply.
2. Connect an Ethernet cable to the Ethernet interface.
3. Optionally, connect a 37-pin female cable to the 37-pin male D connector.
4. Connect a 9-pin male to the 9-pin female RS-232 DB9 sockets.

Calibration Files (XY2-100 Version Only)

Calibration files for both the main laser and the guide laser in .cbt format are included on the USB memory stick included with your shipment. If you are using a third-party controller, you need to load these configuration to your system.

Laser Marking Module: XY2-100 Version — Rear Panel View

Figure 2-9 shows the rear panel of the Laser Marking Module. Table 2-4 provides details on each component.

Figure 2-9. Laser Marking Module - Rear Panel

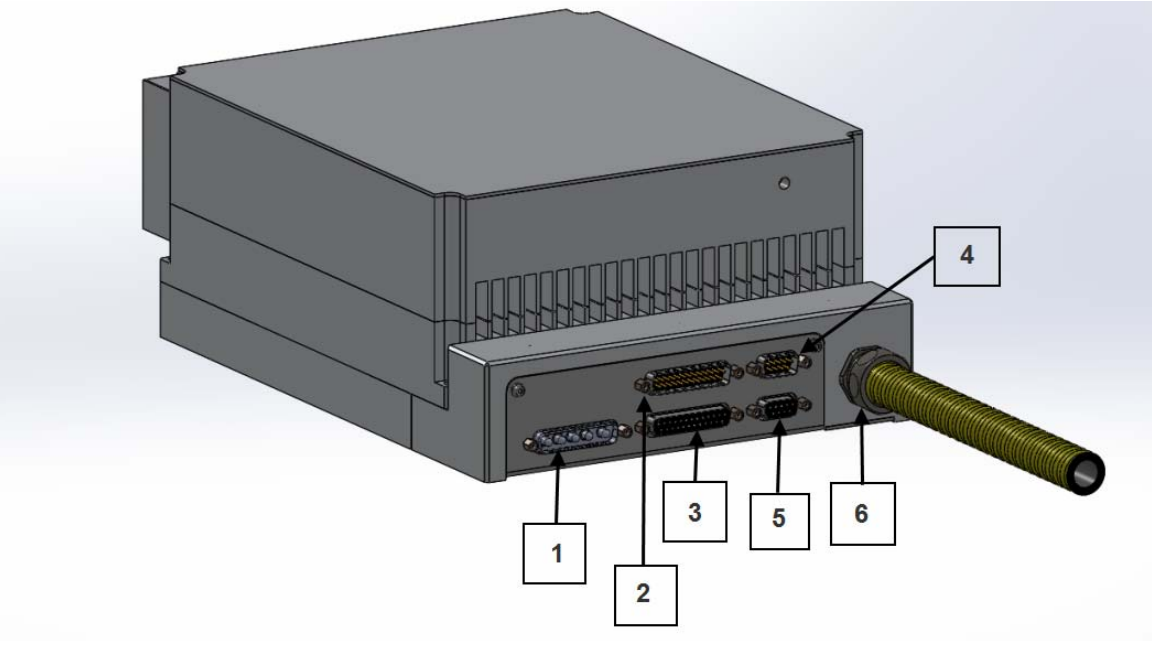


Table 2-4. Rear Panel Descriptions

Item	Component	Description
1	5-pin Male Power Supply	DB 5W5 connector used as the main power supply for the Laser Marking Module.
2	25-pin Male Laser Control	Connector used to control the laser.
3	25-pin Female XY2-100 Sockets	XY2-100 D connector used to control the galvanometers.
4	9-pin Male RS-232	Controls the laser via a RS-232 port.
5	9-pin Female Sockets	D connector for miscellaneous signals.
6	Optical Output	Connects to the optical scanning head by a flexible cord.

Power Supply Pinouts

Figure 2-10 illustrates the male DB 5W5 5-pin Power Supply pinouts.

Figure 2-10. Power Supply Pinouts

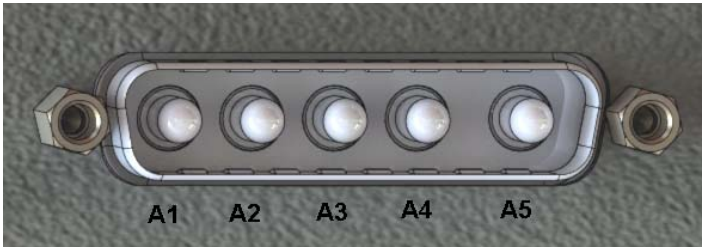


Table 2-5 lists details for the Power Supply pinouts.

Table 2-5. Power Supply Pinout Functions

Pin	Function	Description
A5	-V Scanner	Isolated Scanner Power (+V)-(-V) = 24V to 30V
A4	+V Scanner	
A3	Return	Return For HK and Laser Power. Laser Control and XY2-100 Interface Reference
A2	+V LaserHK	House Keeping Power 24V
A1	+V LaserPower	Laser Diode Power 24V

Power Requirements

Table 2-6. Power Requirements

Type	Description
Scanner Power	24-30V +/-5% @ 10Amp Peak/2 Amp Average
Laser HK Power*	24V +/-5% @ < 1 Amp
Laser Power*	24V +/-5% @ Max Laser Power Watts / (6 Volts)
Laser Power	10W = 1.7 amps 20W = 3.3 amps 30W = 5 amps 50W = 8.3 amps

*Maximum values.

Table 2-7. Power Supply Options

Wiring Options	Pin	Voltage
Split Supply: +/-15 Volt Supply for scanner (10Amp Peak / 2Amp RMS) 24V Supply for laser (8 Amp RMS for 50W laser)	A5	-15V
	A4	+15V
	A3	RET
	A2	+24V
	A1	+24V Safety Switched
Single Supply: 24V Supply for laser and scanner (18Amp Peak / 10Amp RMS)	A5	RET
	A4	+24V
	A3	RET
	A2	+24V
	A1	+24V Safety Switched

Figure 2-11 on page 2-16 shows a split-supply operation for the XY2-100 Version.

Figure 2-12 on page 2-17 shows a single-supply operation for the XY2-100 Version.

Figure 2-11. Split-Supply Operation: XY2-100

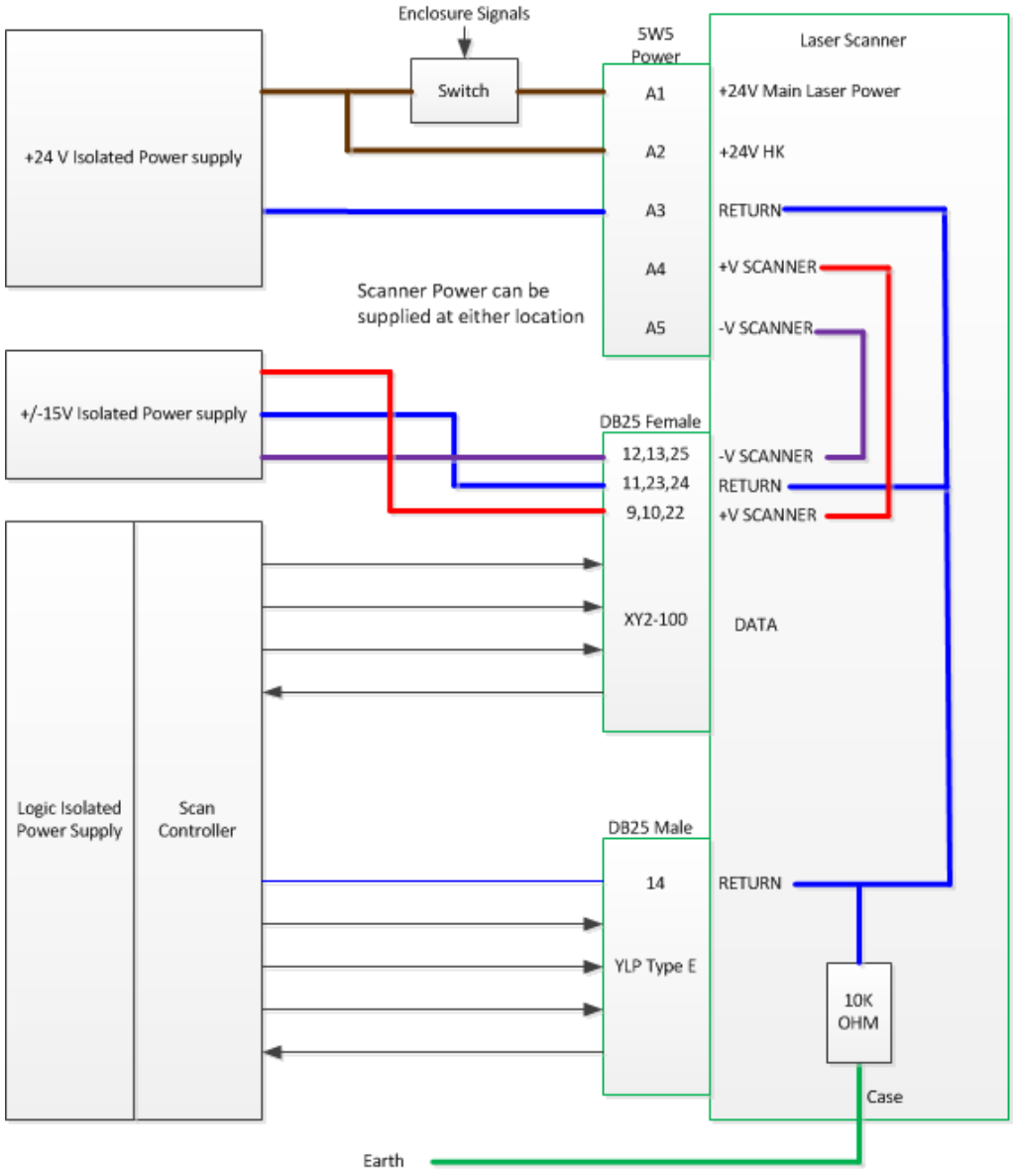
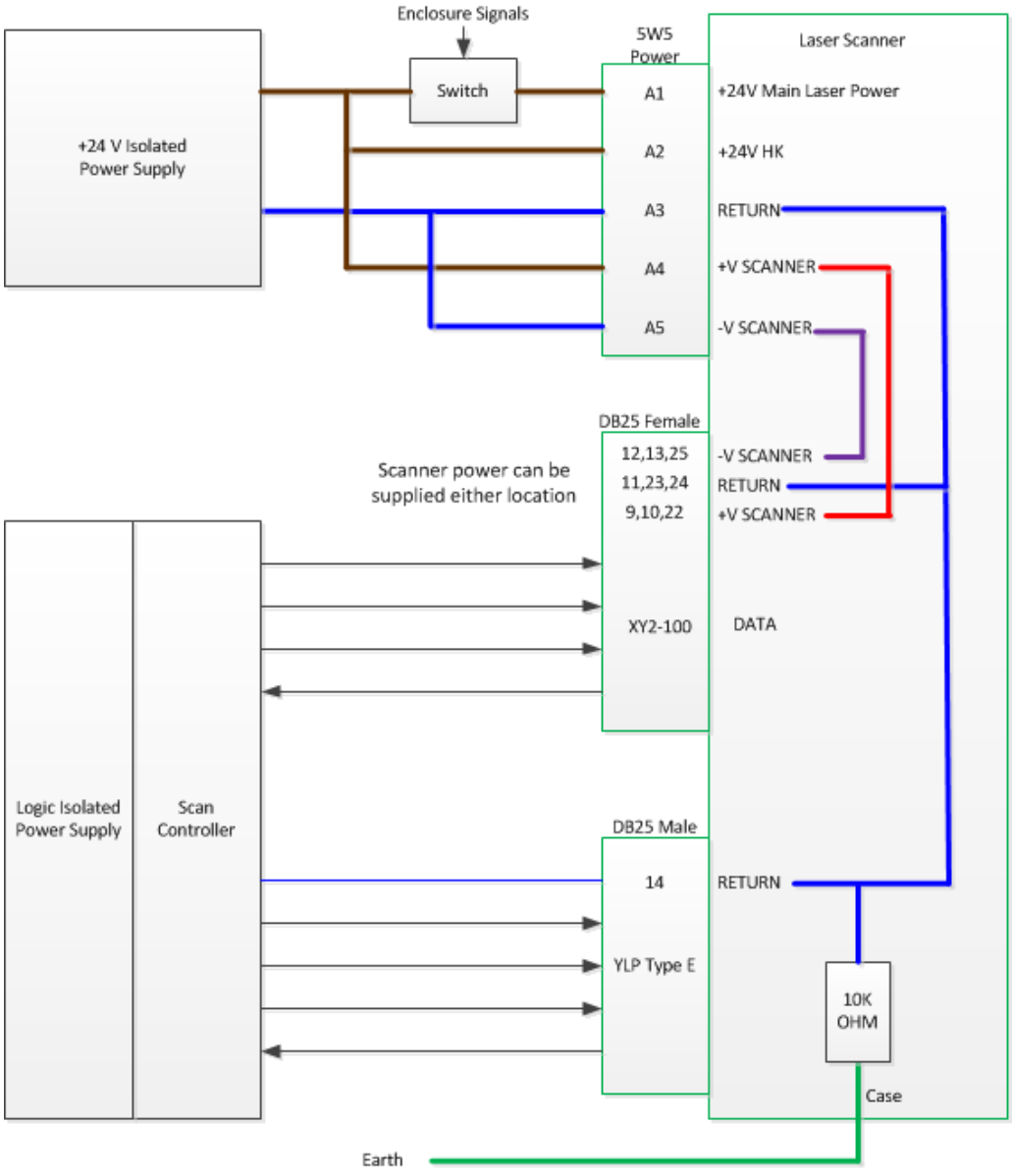


Figure 2-12. Single-Supply Operation: XY2-100



Laser Control Pinouts

Figure 2-13 illustrates the 25-pin Laser Control pinouts.

Figure 2-13. Laser Control Pinouts

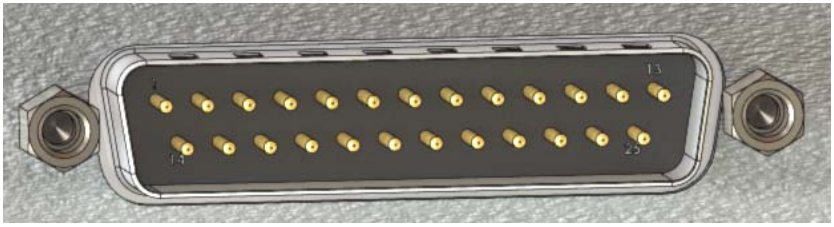


Table 2-8 lists details for the Laser Control pinouts.

Table 2-8. Laser Control Pinout Descriptions

Socket	Description
1	D0
2	D1
3	D2
4	D3
5	D4
6	D5
7	D6
8	D7
9	Latch
10	Auxin1
11	Alarm2
12	Alarm3
13	Auxin2
14	Gnd
15	5V_Aux_Out
16	Alarm1

Socket	Description
17	Gl_Pwr
18	Mo_On
19	Pa_On
20	Sync
21	Alarm0
22	Gl_On
23	Emer_Off
24	Auxin3
25	Auxin4

XY2-100 Sockets

Figure 2-14 illustrates the 25-pin female XY2-100 sockets, which are used for control and status of the galvanometers.

Figure 2-14. XY2-100 Sockets

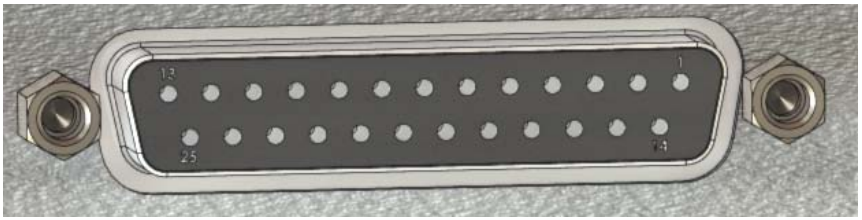


Table 2-8 lists provides details for the XY2-100 sockets.

Table 2-9. XY2-100 Socket Descriptions

Socket	Name	I/O	Description
1	CK-	O	2Mhz Clock
14	CK+	O	
2	SYNC-	O	Sync Signal
15	SYNC+	O	
3	XD-	O	X Channel Data
16	XD+	O	
4	YD-	O	Y Channel Data
17	YD+	O	
5	ZD-	O	Z Channel Data (if Z axis is present)
18	ZD+	O	
6	STAT-	I	XYZ-100 Status Word
19	STAT+	I	
7	NC	-	No Connect
20	NC	-	
8	NC	-	

Socket	Name	I/O	Description
21	NC	I	No Connect
9	+V Servo	PWR	Positive Power Supply for galvanometers. 24-30V referenced to -V Servo. Connected to A4.
22	+V Servo		
10	+V Servo		
23	GND	PWR	GND Reference for pins 1-6 and 14-19.
11	GND		
24	GND		
12	-V Servo	PWR	Negative Power Supply Return for galvanometers. Connected to A5.
13	-V Servo		
25	-V Servo		

Miscellaneous Signal Sockets

Figure 2-15 illustrates the 9-pin female sockets.

Figure 2-15. 9-Pin Female Signal Sockets

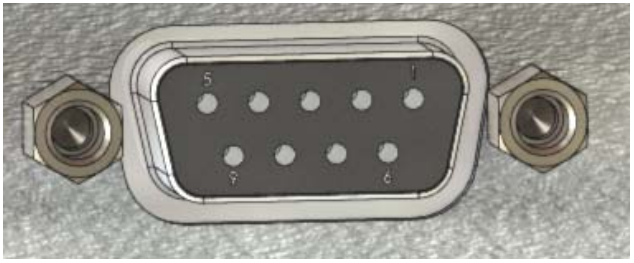


Table 2-10 lists provides details for the 9-pin female pinouts.

Table 2-10. 9-Pin Socket Descriptions

Socket	Name	Description
1	A1	Reserved
2	B1	Reserved
3	GL_ON	Reserved
4	FL_ON	Reserved
5	NC	Reserved
6	A2	Reserved
7	B2	Reserved
8, 9	GND	Reserved

Note: Do not connect to “Reserved”

RS-232 DB-9 Pinouts

Figure 2-16 illustrates the 9-pin male RS-232 DB9 pinouts.

Figure 2-16. 9-Pin Male Pinouts

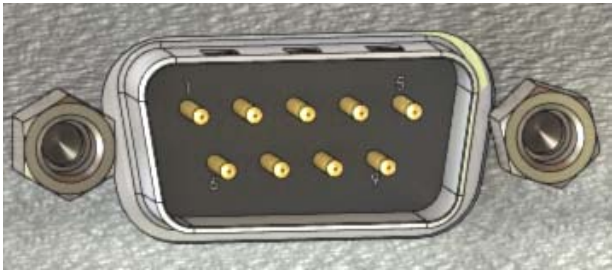


Table 2-11 lists provides details for the RS-232 DB9 pinouts.

Table 2-11. 9-Pin Pinout Descriptions

Socket	Description
1	Reserved - Do not connect
2	RX Input - Receive
3	TX Output - Transmit
4	Reserved - Do not connect
5	Common
6, 7, 8, 9	Reserved - Do not connect

Laser Marking Module: Integrated Scan Controller Version — Rear Panel View

Figure 2-17 shows the rear panel of the Laser Marking Module with Integrated Scan Controller. Table 2-12 provides details on each component.

Figure 2-17. Laser Marker Module - Rear Panel

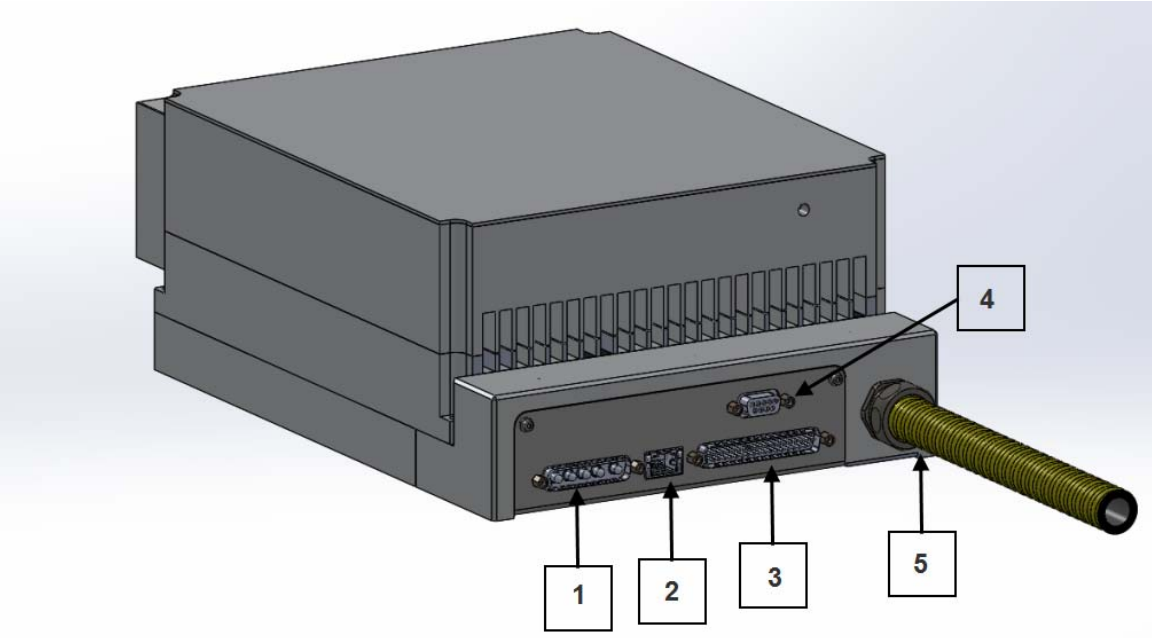


Table 2-12. Rear Panel Descriptions

Item	Component	Description
1	5-pin Male Power Supply	DB 5W5 connector used as the main power supply for the Laser Marking Module.
2	Ethernet Interface	Communication from the IPG ScanPack .dll and system console is performed over Ethernet. Configure an Ethernet connection for DHCP. For optimal results, IPG recommends you use a direct Ethernet connection (capable of 100Mbit/s) directly from the PC to the Scan Controller. To change an IP Address to static, run the IPG Scan Controller Upgrade Utility. See “Installing the Scan Controller Upgrade Utility” on page 3-24 for details.

Item	Component	Description
3	37-pin Male D Connector	(Optional) Used for external interface to external controllers, encoders, and safety logic.
4	9-pin Female DB9 RS-232	The RS-232 port can be used as a system console to set up IP addresses.
5	Optical Output	Connects to the optical scanning head by a flexible cord.

Power Supply Pinouts

Figure 2-18 illustrates the male DB 5W5 5-pin Power Supply pinouts.

Figure 2-18. Power Supply Pinouts

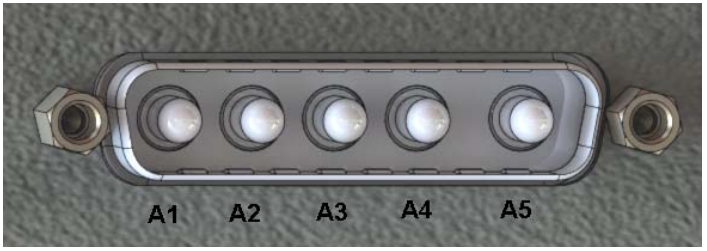


Table 2-13 lists details for the Power Supply pinouts.

Table 2-13. Power Supply Pinout Functions

Pin	Function
A5	-V Servo
A4	+V Servo
A3	GND Laser
A2	+V LaserAux
A1	+V LaserPower

Power Configuration Options

Table 2-14 lists details for the Power configuration options.

Table 2-14. Power Supply Options

Wiring Options	Pin	Voltage
Split Supply: +/-15 Volt Supply for scanner 24V Supply for laser	A5	-15V
	A4	+15V
	A3	GND
	A2	+24V
	A1	+24V Safety Switched

Single 24V Supply for laser and scanner	A5	GND
	A4	+24V
	A3	GND
	A2	+24V
	A1	+24V Safety Switched

Figure 2-19 on page 2-28 shows a split-supply operation for the Integrated Scan Controller Version.

Figure 2-20 on page 2-29 shows a single-supply operation for the Integrated Scan Controller Version.

Figure 2-19. Split-Supply Operation: Integrated Scan Controller

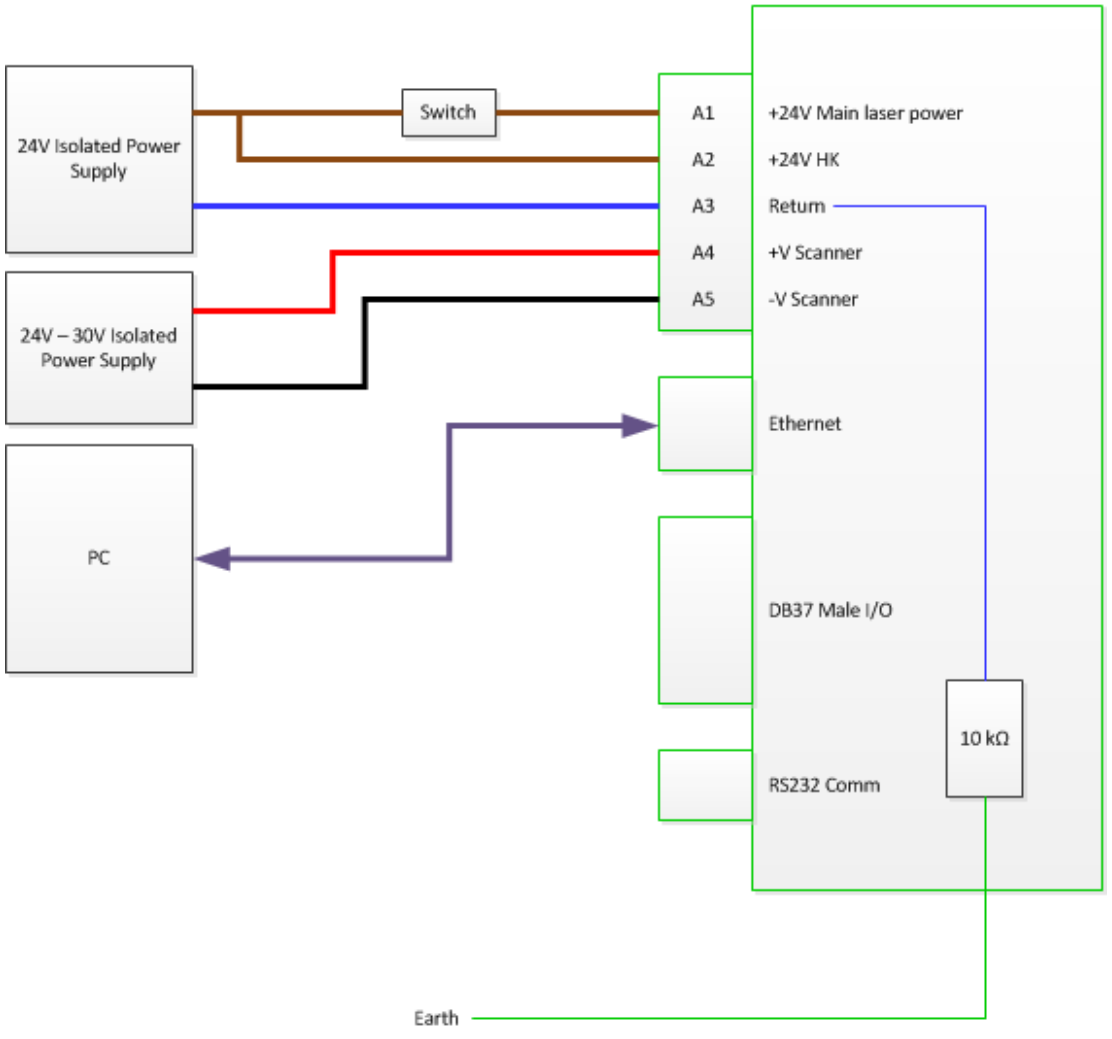
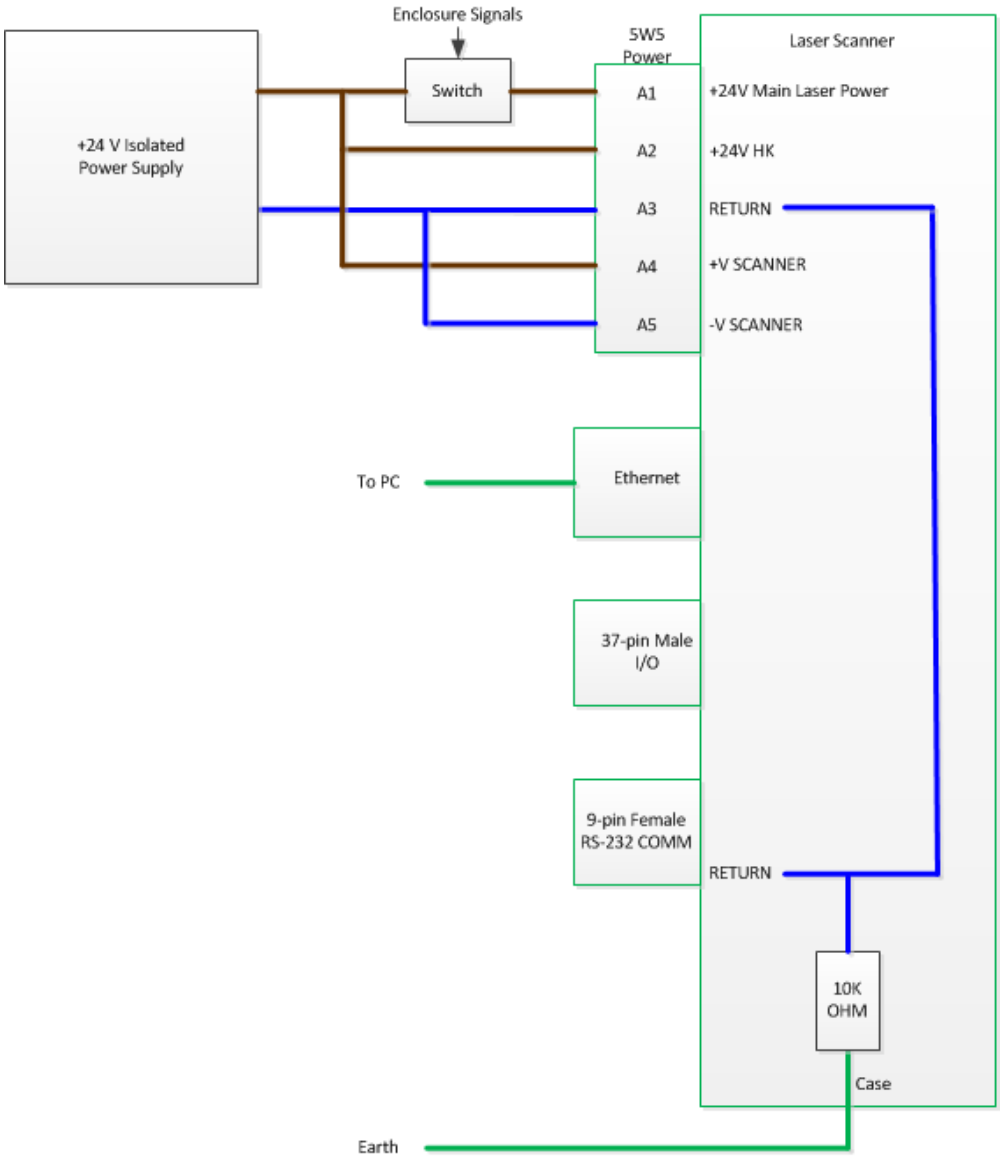


Figure 2-20. Single-Supply Operation: Integrated Scan Controller



37-Pin I/O Pinouts

Figure 2-21 illustrates the 37-pin I/O pinouts.

Figure 2-21. 37-Pin I/O Pinouts

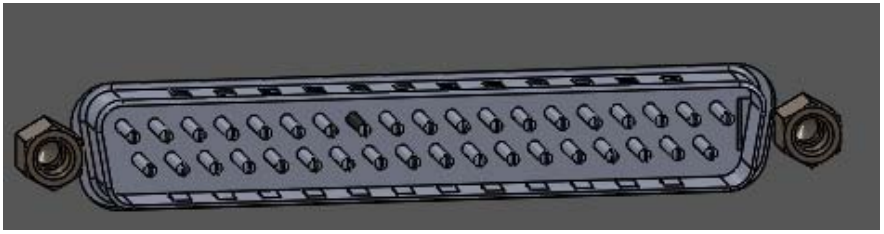


Table 2-15 lists details for the 37-pin I/O pinouts.

Table 2-15. 37-Pin I/O Pinout Descriptions

Pin	Name	I/O	Description
1	Active	Out	Mark in Progress
20	GND	3VTTL	
2	Ready	Out	Ready/Waiting Signal
21	GND	3VTTL	
3	Error	Out	Error Condition
22	GND	3VTTL	
4	Start	In	Start Signal Input
23	GND	3VTTL	Pulled up to 3.3V
5	Stop	In	Stop Signal Input Active Low
24	GND	3VTTL	Pulled up to 3.3V
6	GPIO[0]	In/Out	General Purpose Input/Output for Synchronization
25	GND	3VVTL	Pulled up to 3.3V
7	GPIO[1]	In/Out	General Purpose Input/Output for Synchronization
26	GND	3VVTL	Pulled up to #.3V
8	A_Axis_A+	In/Out	Axis A Phase A
27	A_Axis_A-	RS-422	

9	A_Axis_B+	In/Out	Axis A Phase B
28	A_Axis_B-	RS-422	
10	A_Axis_Z+	In	Axis A Phase Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V)
29	A_Axis_Z-	RS-422	
11	B_Axis_A+	In/Out	Axis B Phase A
30	B_Axis_A-	RS-422	
12	B_Axis_B+	In/Out	Axis B Phase B
31	B_Axis_B-	RS-422	
13	B_Axis_Z+	In	Axis B Phase Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V)
32	B_Axis_Z-	RS-422 or 3VTTL	
14	C_Axis_A+	In/Out	Axis C Phase A
33	C_Axis_A-	RS-422	
15	C_Axis_B+	In/Out	Axis C Phase B
34	C_Axis_B-	RS-422	
16	C_Axis_Z+	In/Out	Axis C Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V) or ClkIn/ClkOut Differential for Synchronization to laser.
35	C_Axis_Z-	RS-422 or 3VTTL	
17	FiberInterlockA0	Out Relay	FiberInterlock is safe when 1 is connected to 0.
36	FiberInterlockA1		
18	FiberInterlockB0	Out Relay	FiberInterlock is safe when 1 is connected to 0.
37	FiberInterlockB1		
19	GND	Out	Logic Ground

RS-232 DB9 9-Pin Sockets

Figure 2-22 illustrates the 9-pin female RS-232 DB9 sockets.

Figure 2-22. 9-Pin Female Sockets

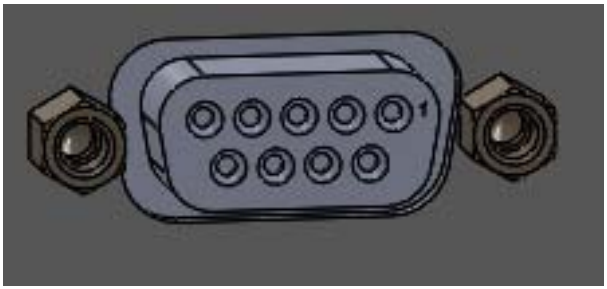


Table 2-16 lists provides details for the RS-232 DB9 sockets.

Table 2-16. 9-Pin Socket Descriptions

Socket	Description
1	Reserved - Do not connect
2	Receive Data Output
3	Transmit Data Input
4	Reserved - Do not connect
5	GND
6	Data Set Ready Internally Connected to Pin 4 Data Terminal Ready
7	Request to Send Internally Connected to Pin 8 Clear to Send
8, 9	Reserved - Do not connect

Installing the IPG ScanPack and WinLase 6

Overview

This chapter explains how to install IPG ScanPack and the WinLase 6 laser marking software on your system for use with the Laser Marker Module with the Integrated Scan Controller. It also explains how to activate the WinLase 6 program and configure a LAN connection over Ethernet.

Requirements

The following requirements are necessary:

- Windows 7 or 8 Operating System
- IPG Laser Marker Module with Integrated Scan Controller
- IPG ScanPack software
- WinLase 6 software
- WinLase 6 licensing key for product activation

Installing IPG ScanPack

You need to install IPG ScanPack to use the WinLase 6 program with the Laser Marker Module with the Integrated Scan Controller.

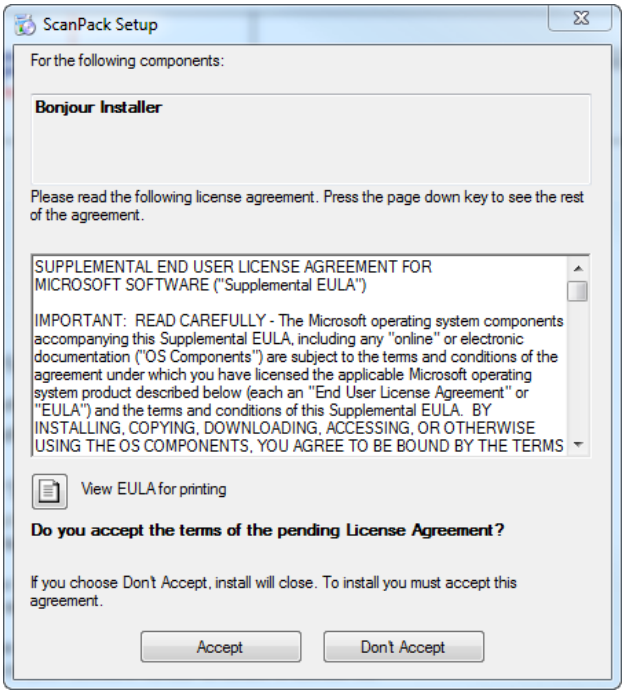
ScanPack is a .dll file in which WinLase 6 interfaces for communicating with your Scan Controller over Ethernet. The ScanPack installation program installs Bonjour (a protocol that discovers IP addresses over the network), Microsoft Visual C++ Runtime Libraries, and the ScanPack dll on your system.

Before installing ScanPack, uninstall any previous versions of ScanPack, if applicable.

To install IPG ScanPack:

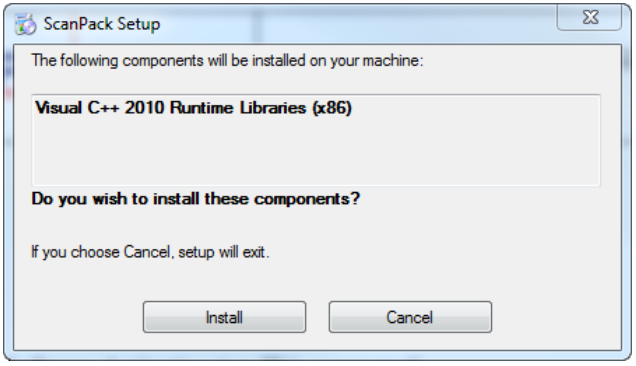
1. Open a web browser and go to **software.ipgphotonics.com**.
2. Click the Marker folder.
3. Click the ScanPack folder.
4. Download the ScanPack.zip file to your computer.
5. Once downloaded, extract the ScanPack.zip file. A folder called ScanPack is created.
6. Open the folder and run **setup.exe** and click **Next**. The Bonjour Installer appears as shown in Figure 3-1.

Figure 3-1. Bonjour Installer



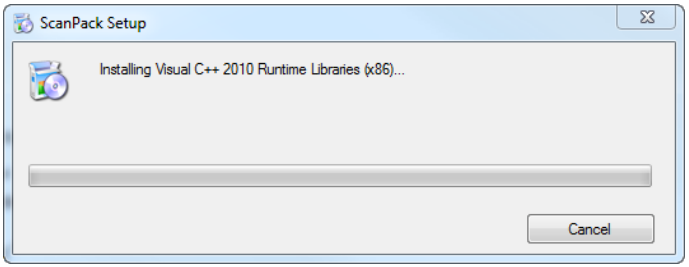
7. Click **Accept** to accept the license agreement. The following dialog box appears as shown in Figure 3-2.

Figure 3-2. Visual C++ 2010 Runtime Libraries Installation



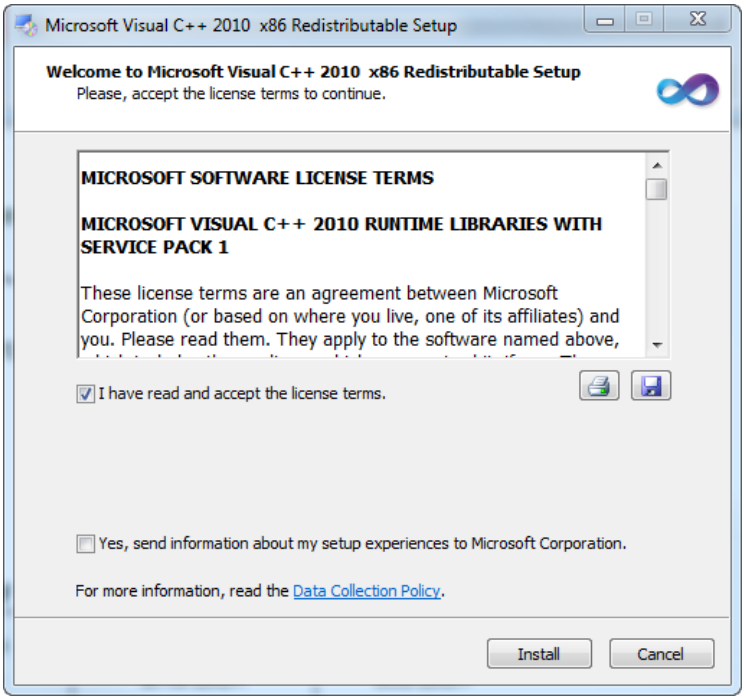
8. Click **Install** to installation Visual C++ 2010 Runtime Libraries to your system. The following status message appears.

Figure 3-3. Status Message



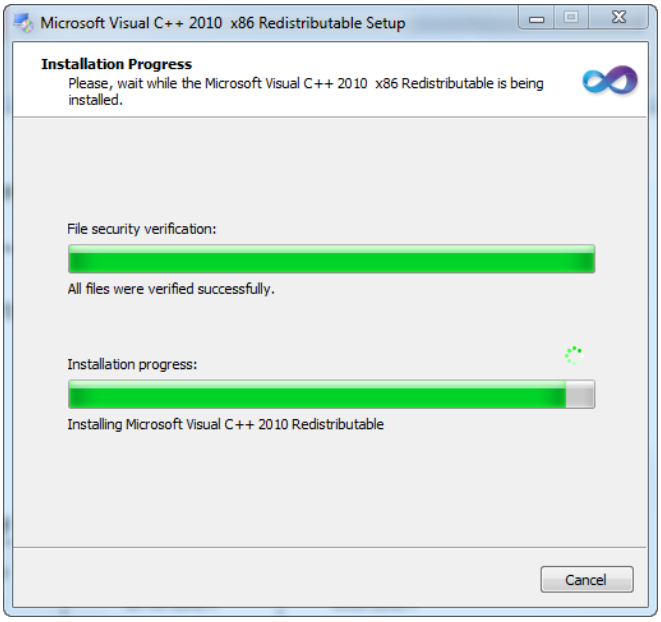
Next, the Microsoft Visual C++ 2010 x86 Redistributable Setup window appears as shown in Figure 3-4.

Figure 3-4. Microsoft Visual C++ 2010 x86 Redistributable Setup



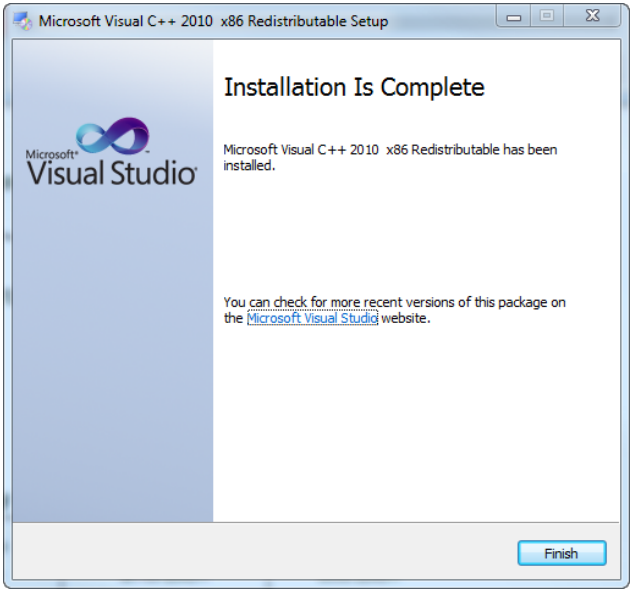
9. Click **I have read and accept the license terms** and click **Install**. The following window appears with the Microsoft Visual C++ 2010 x86 Redistributable installation progress as shown in Figure 3-5.

Figure 3-5. Installation Progress Window



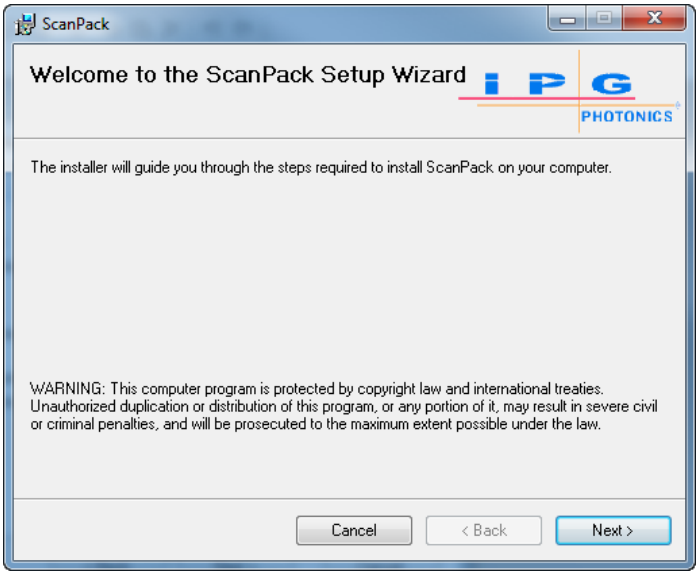
Next, the Installation is Complete window appears as shown in Figure 3-6.

Figure 3-6. Installation Is Complete



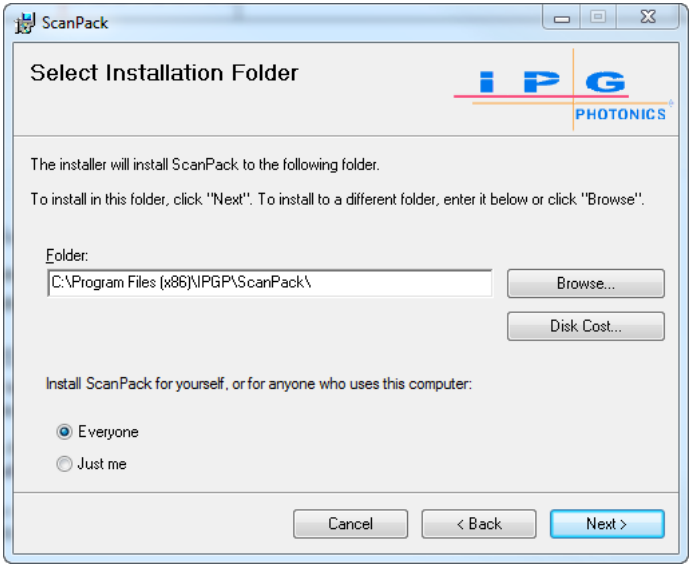
10. Click **Finish**. The ScanPack Setup Wizard appears a shown in Figure 3-7.

Figure 3-7. ScanPack Setup Wizard



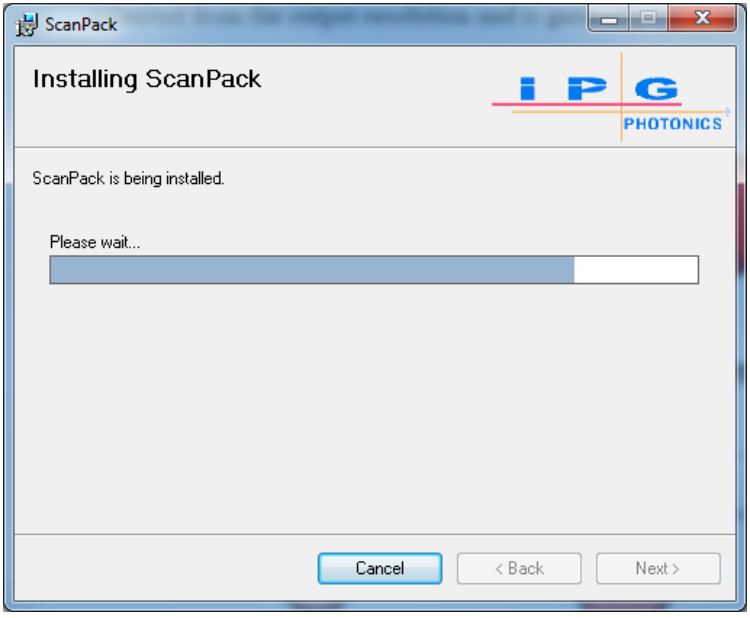
11. Click **Next** to proceed. The Select Installation Folder window appears as shown in Figure 3-8.

Figure 3-8. ScanPack Setup - Select Installation Folder



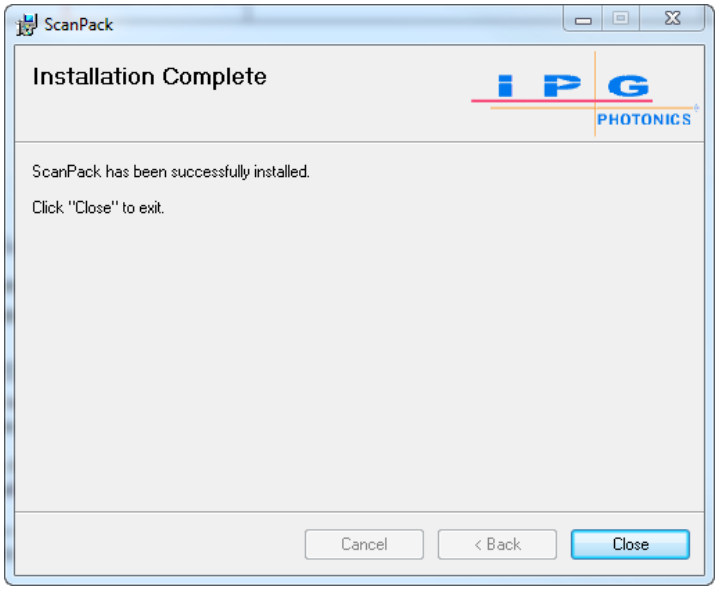
12. Click **Next** to accept the default Start Menu folder.
    a. Click **Browse** if you want to change the default Start menu to another location.
    b. Click **Everyone** to allow all users to have access to the ScanPack dll or **Just me** if only you want access.
13. Click **Next** to begin the installation. The Installation Progress window appears as shown in Figure 3-13.

Figure 3-9. Installing ScanPack



14. Click **Next** to proceed. The Installation Complete window appears as shown in Figure 3-10.

Figure 3-10. Installation Complete



15. Click **Close** to exit the program. ScanPack is successfully installed on your system.

Installing the WinLase 6 Software

The WinLase 6 program is only compatible with the Laser Marker Module — Integrated Scan Controller version.

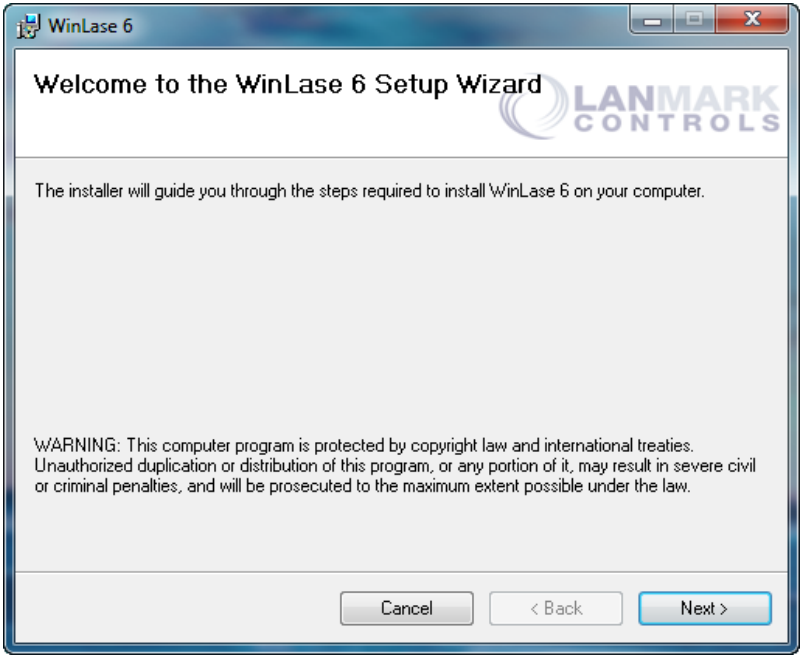
Before installing the WinLase 6 software, you need to uninstall any previous versions of WinLase 6, if applicable. You also need to first install IPG ScanPack as explained in “Installing IPG ScanPack” on page 3-2.

With WinLase 6, you can edit nodes and vectors and change properties without using an external graphics software package. You can also keep multiple instances of the software open for side-by-side editing of jobs.

To install the WinLase 6 software:

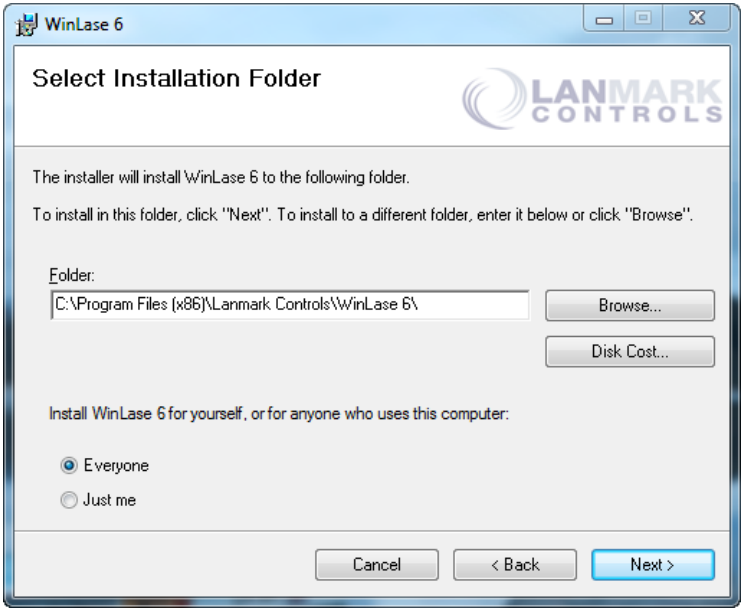
1. Open a web browser and go to **software.ipgphotonics.com**.
2. Click the Marker folder.
3. Click the WinLase6 folder.
4. Download the WinLase6.zip file to your computer.
5. Once downloaded, extract the WinLase 6.zip file. A folder called WinLase6 is created.
6. Open the folder and run **setup.exe**. The WinLase 6 Setup Wizard appears as shown in Figure 3-11.

Figure 3-11. WinLase 6 Setup Wizard



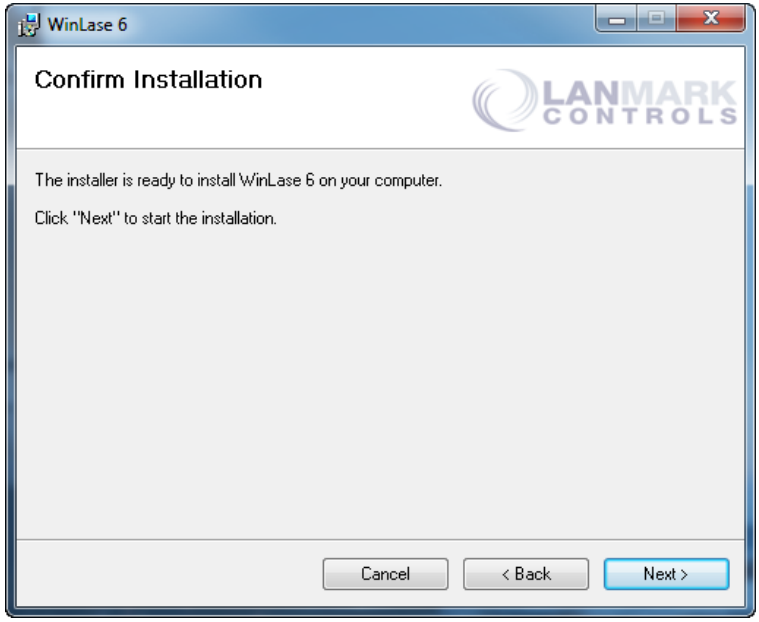
7. Click **Next.** The Select Installation Folder window appears as shown in Figure 3-12.

Figure 3-12. WinLase 6 Setup - Select Installation Folder



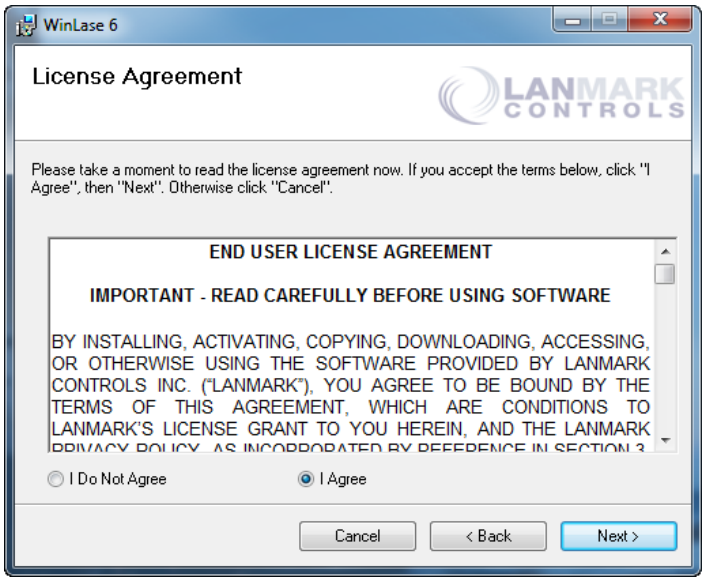
8. Click **Next** to accept the default Start Menu folder.
   a. Click **Browse** if you want to change the default Start menu to another location.
   b. Click **Everyone** to allow all users to access the WinLase 6 program or **Just me** if only you want access.
9. Click **Next**. The Confirm Installation window appears as shown in Figure 3-13.

Figure 3-13. WinLase 6 Setup - Confirm Installation



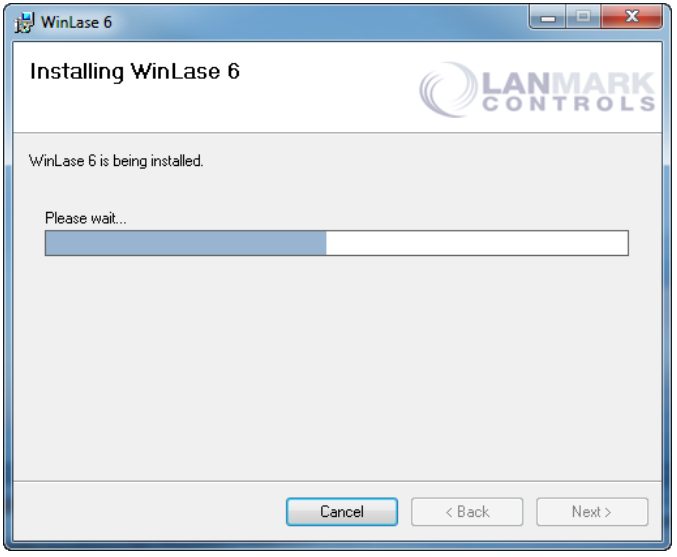
10. Click **Next** to proceed. The License Agreement window appears as shown in Figure 3-14.

Figure 3-14. WinLase 6 Setup - License Agreement



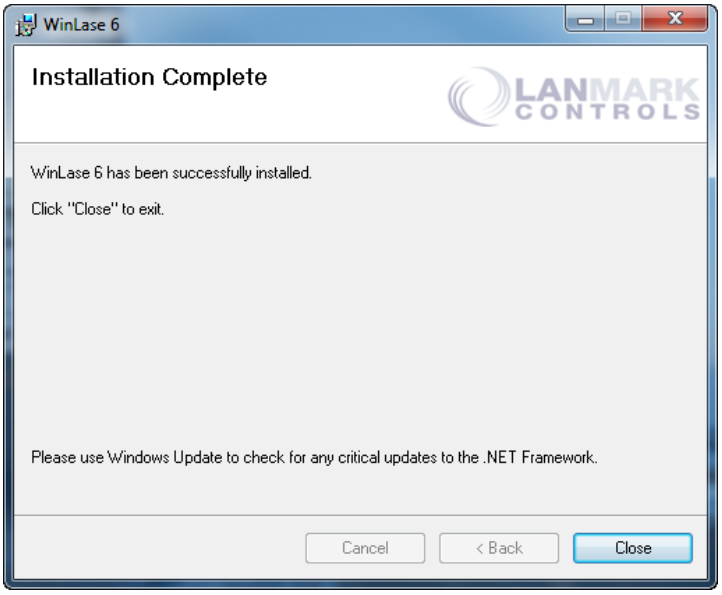
11. Click **I Agree** to accept the License Agreement.
12. Click **Next** to proceed. The Installing WinLase 6 window appears as shown in Figure 3-15.

Figure 3-15. WinLase 6 Setup - Installing WinLase 6



13. Once installation is complete, the Installation Complete window appears as shown in Figure 3-16.

Figure 3-16. WinLase 6 Setup - Installation Complete



14. Click **Close** to exit the window. WinLase 6 is successfully installed on your system.
15. See “Activating WinLase 6” on page 3-15 to activate the WinLase 6 program using the license key provided by IPG Photonics.

Note

You cannot use WinLase 6 without activating it with a valid license key.

Activating WinLase 6

This section explains how to:

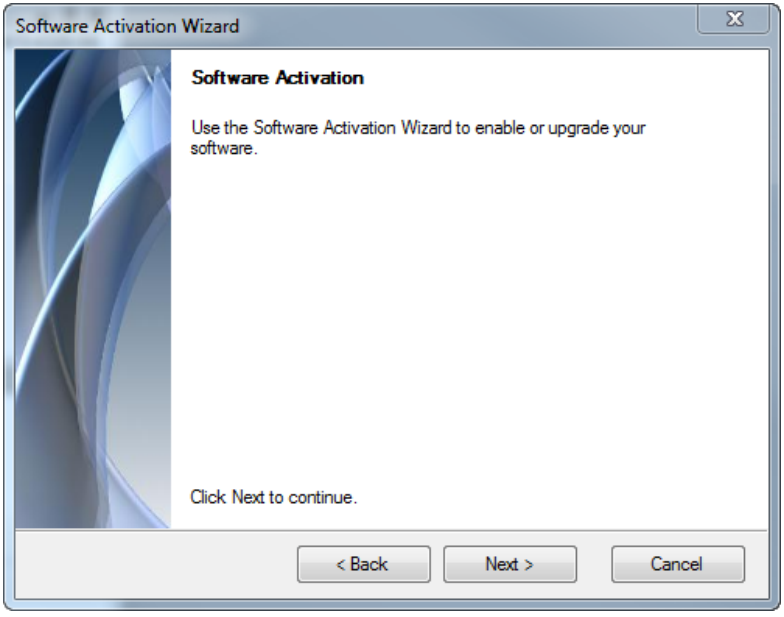
- Create a license file request.
- Emailing the license file request to IPG Photonics for obtaining a license key.
- Activating WinLase 6 on your computer.

Creating a License File Request

To create a license file request:

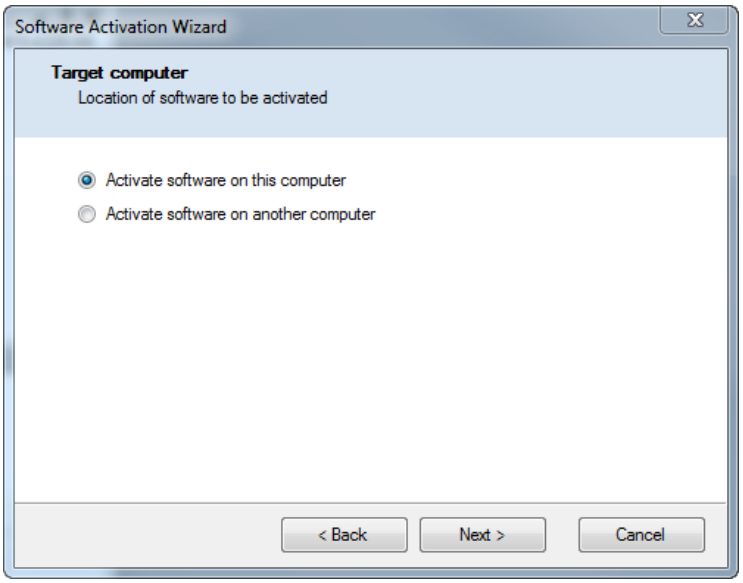
1. Open the WinLase 6 program. A message displays prompting you for a license key to use the product.
2. Click **Cancel** to proceed.
3. Select **Software Activation** from the **Help** menu. The Software Activation Wizard appears as shown in Figure 3-17.

Figure 3-17. Software Activation Wizard



4. Click **Next** to continue. The following window appears as shown in Figure 3-18.

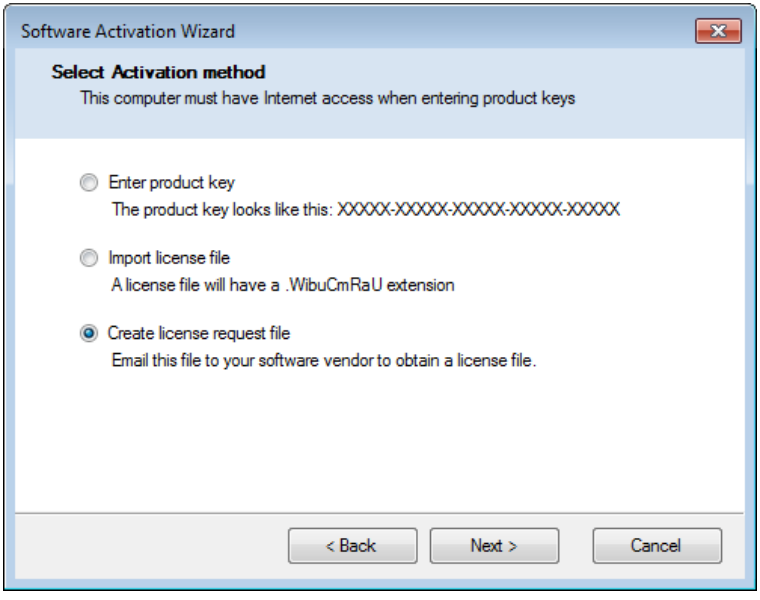
Figure 3-18. Activate Software on This Computer



5. Click **Activate software on this computer** and click **Next** to continue.

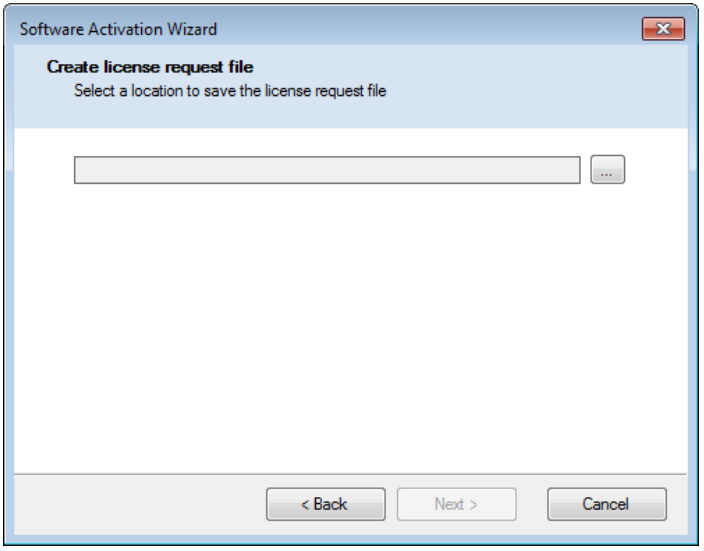
   The Select Activation Method window appears as shown in Figure 3-19.

Figure 3-19. Select Activation Method



6. Click **Create license request file** and click **Next**. The Create License Request File appears as shown in Figure 3-20.

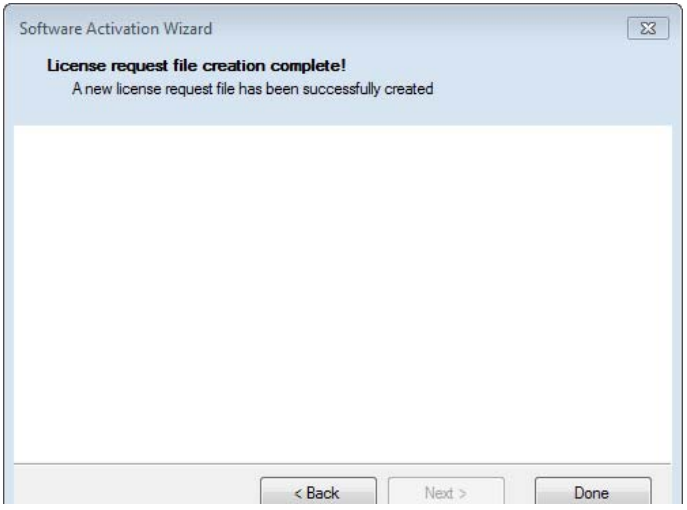
Figure 3-20. Create License Request File



7. Save the file with the serial number of the laser to a location on your computer. For example, 15041235.WibuCmRaC.

8. Click **Next** to continue. The following confirmation message appears as shown in Figure 3-21.

Figure 3-21. License Request Complete



9. Click **Done** to exit WinLase 6.
10. Email the license request file from the saved location to IPG Photonics at:

    marker@ipgphotonics.com

11. Enter "**Winlase6 License Request"** in the subject line of the email.

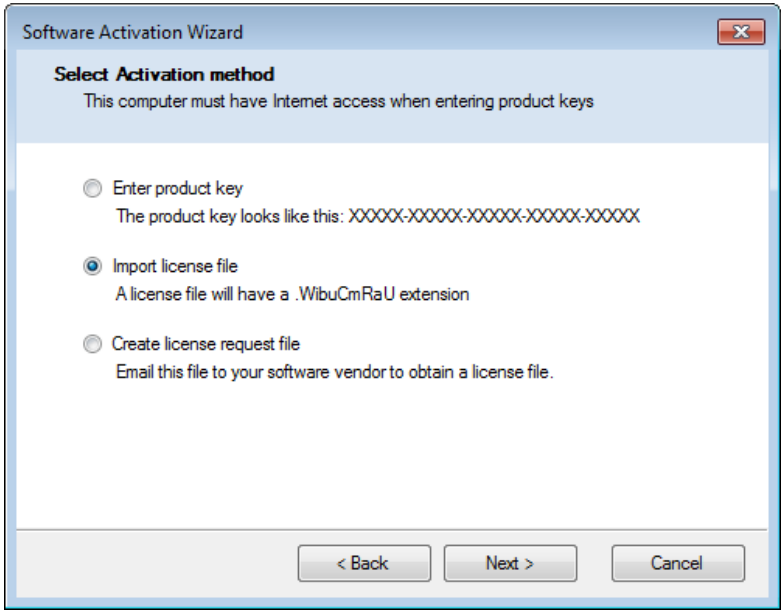
    IPG Photonics emails you the license file once your email is received. The license key is valid for one activation only (one user).

Activating WinLase 6 with a License Key

To activate WinLase 6 with a license key:

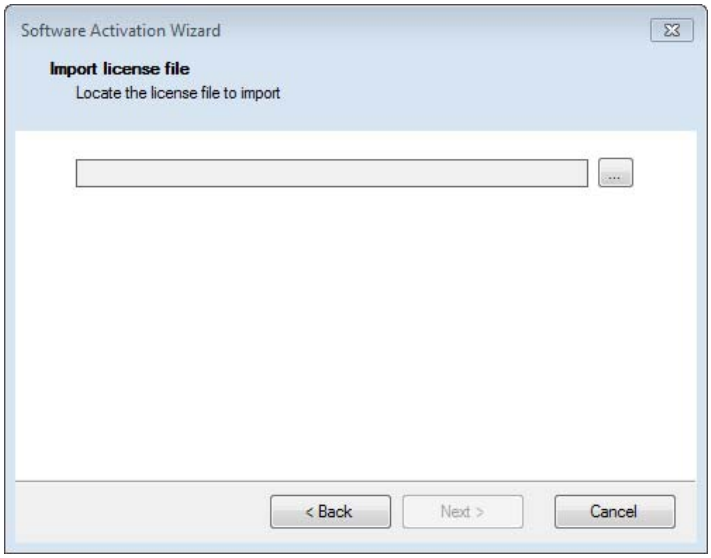
1. Once you receive the license file from IPG Photonics, follow steps 1 to 5 in "Creating a License File Request" on page 3-15.
2. Click **Import license file**.

Figure 3-22. Software Activation Wizard - Import License File



3. Click **Next** to continue. The following window appears as show in Figure 3-23.

Figure 3-23. Import License File From Saved Location



4. Import the license file to the computer where you generated the request for the license.

Note Once the file is activated on your computer, it cannot be used on another computer.

5. Click **Next** to continue. A message appears confirming that the WinLase 6 activation was successful.
6. Click **Done** to exit the window. WinLase 6 is activated and ready for use on your computer.
7. See “WinLase 6 Quick Start” on page 4-1 for step-by-step instructions for creating and running a laser marker job.

Configuring a DHCP IP Address

This section explains how to configure a DHCP IP address, which is necessary for use with WinLase 6 marking software with the Laser Marker Module — Scan Controller version.

For optimal configuration, IPG recommends that you use an Ethernet connection (capable of 100Mbit/s) directly from the host PC to the Laser Marker with the Integrated Scan Controller.

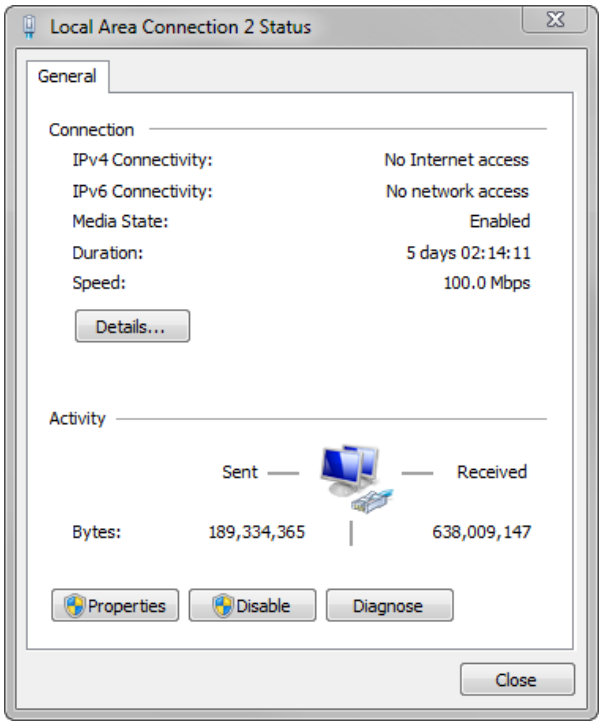
Note

If you want to configure a static IP address, you need to run the Scan Controller Upgrade Utility. See “Installing the Scan Controller Upgrade Utility” on page 3-24 and “Running the Scan Controller Upgrade Utility” on page 3-29 to for step-by-step instructions for changing your network settings.

To configure a DHCP IP Address:

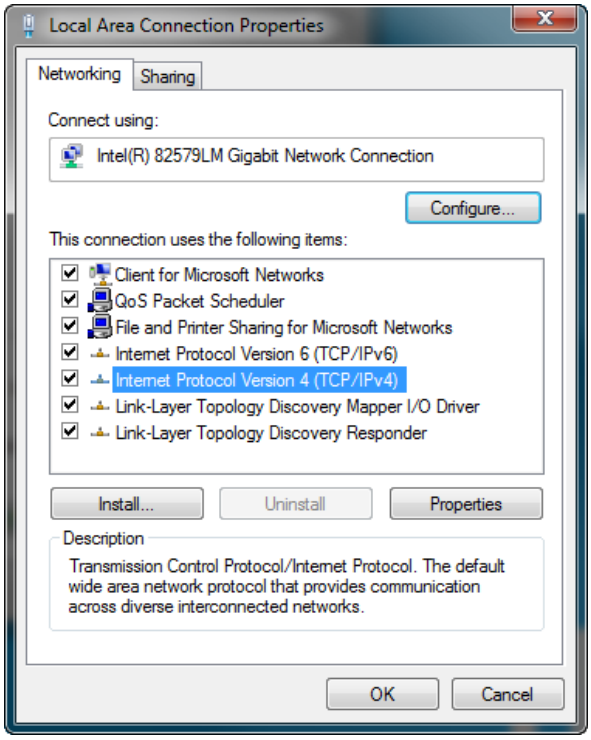
1. Connect your computer to the Ethernet interface on the rear of the Laser Marker/ Scan Controller using a standard Ethernet cable.
2. Go to **Control Panel -> Network and Internet -> Network and Sharing Center**.
3. Click **Change adapter settings**.
4. Select a Local Area Connection icon. The following window appears as shown in Figure 3-24.

Figure 3-24. Local Area Connection Status



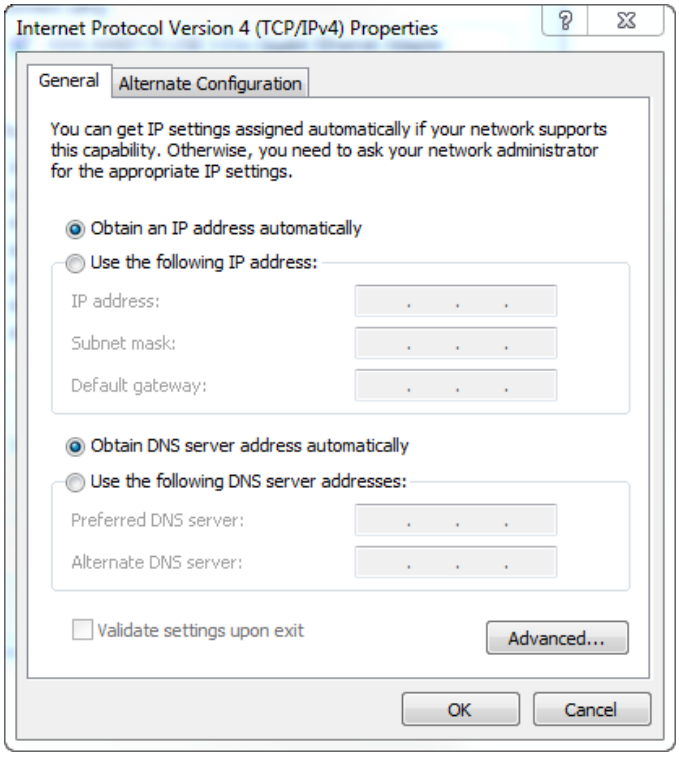
5. Click **Properties**. The following window appears as shown in Figure 3-25.

Figure 3-25. Local Area Connection Properties



6. Select **Internet Protocol Version 4 (TCP/IPv4).**
7. Click **Properties**. The following window appears as shown in Figure 3-26.

Figure 3-26. Internet Protocol Version 4 Properties



8. Click the **Obtain an IP address automatically** radio button to automatically assign a DHCP IP address.
9. Click the **Obtain an DNS server address automatically** radio button to automatically assign the DNS server address.
10. Press **OK** to accept your changes.

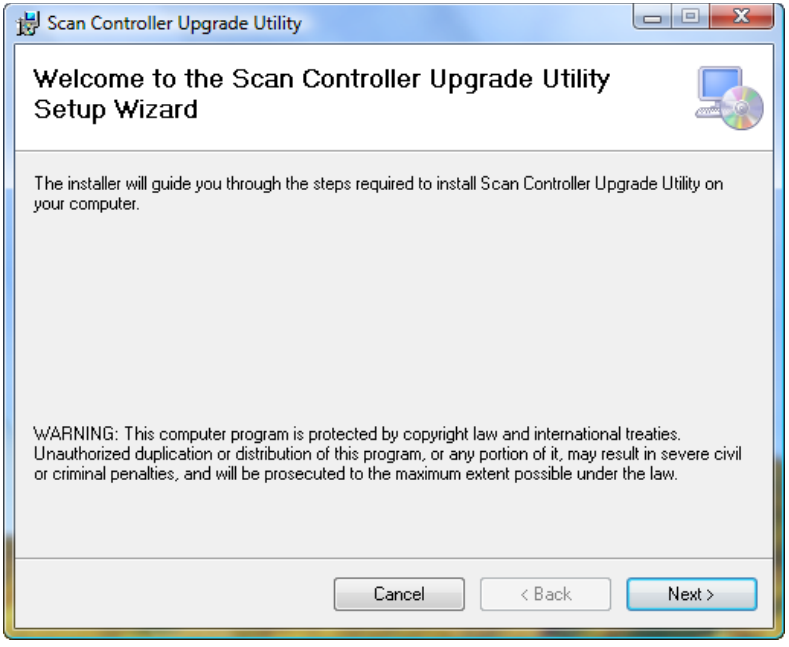
Installing the Scan Controller Upgrade Utility

You set a static IP address and change the host name of the Scan Controller using the Scan Controller Upgrade Utility.

To install the Scan Controller Upgrade Utility:

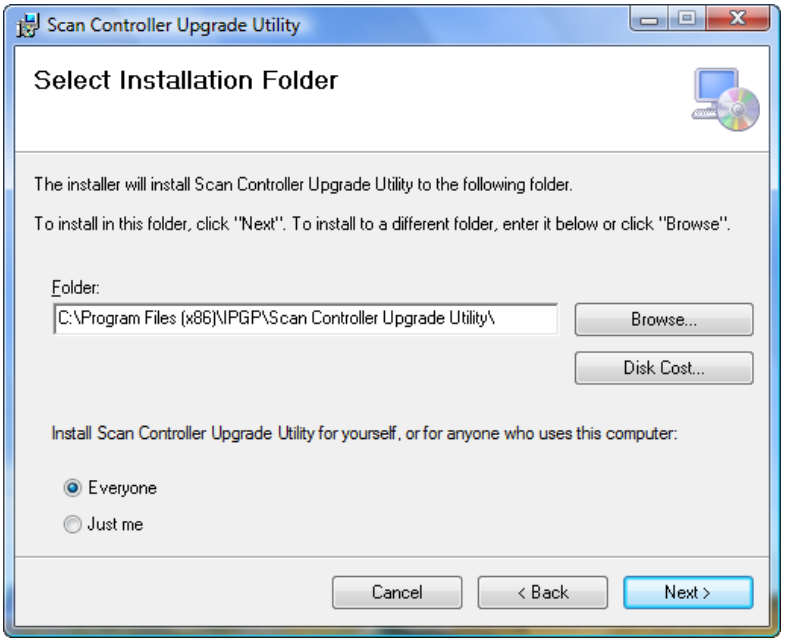
1. Open a web browser and go to **software.ipgphotonics.com**.
2. Click the Marker folder.
3. Click the Utilities folder.
4. Download the ScanControllerUtility.zip file to your computer.
5. Once downloaded, extract the Utilities.zip file. A folder called Utilities is created.
6. Open the folder and run **setup.exe** and click **Next**. The following windows appears as shown in Figure 3-27.

Figure 3-27. Scan Controller Upgrade Utility Window



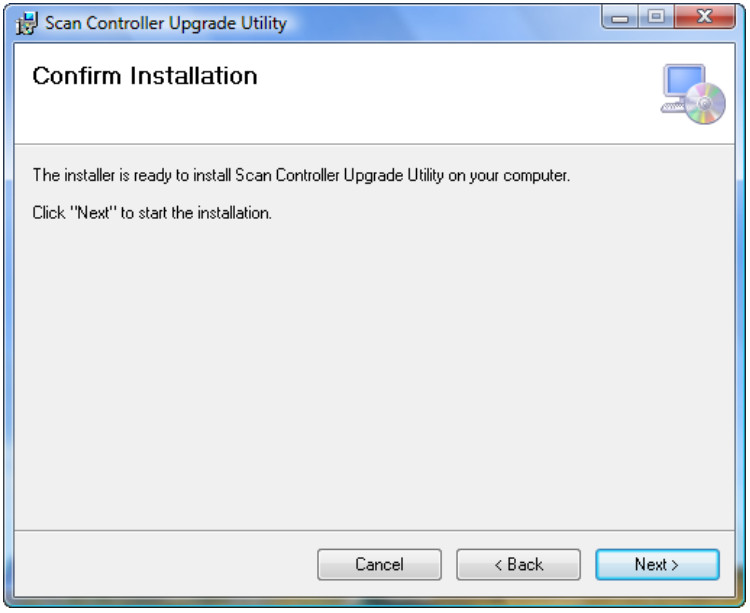
7. Click **Next.** The Select Installation Folder window appears as shown in Figure 3-28.

Figure 3-28. Select Installation Folder



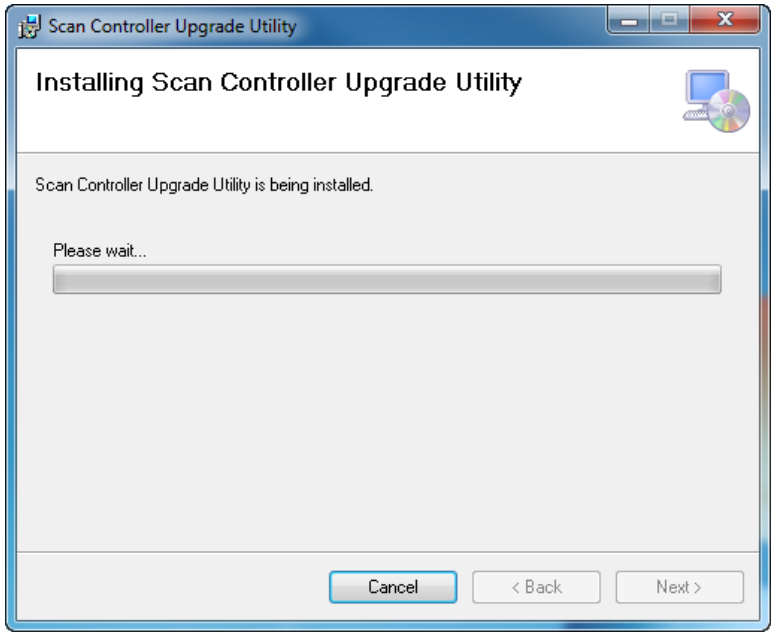
8. Click **Next** to accept the default Start Menu folder.
   a. Click **Browse** if you want to change the default Start menu to another location.
   b. Click **Everyone** to allow all users to access the Scan Controller Upgrade Utility or **Just me** if only you want access.
9. Click **Next**. The Confirm Installation window appears as shown in Figure 3-29.

Figure 3-29. Confirm Installation Folder



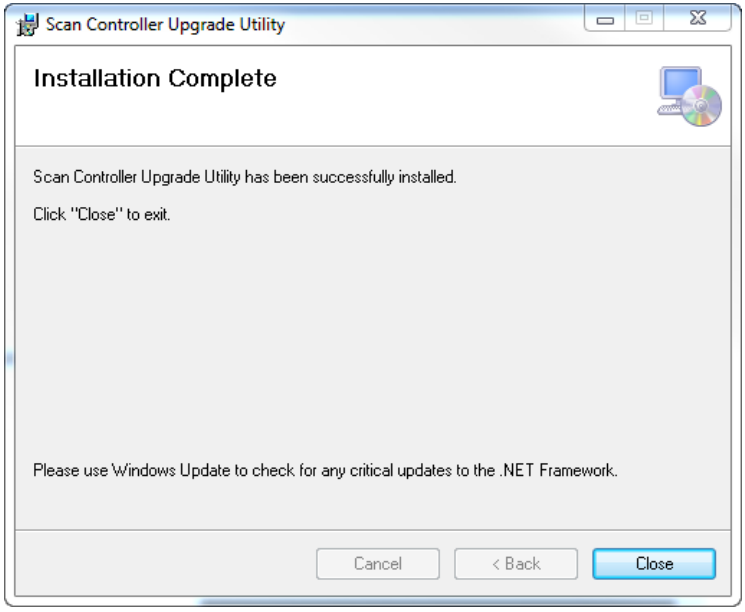
10. Click **Next** to continue with installation. The Installation Progress window appears as shown in Figure 3-30.

Figure 3-30. Installation Progress Window



11. Click **Next** to continue with installation as shown in Figure 3-31.

Figure 3-31. Installation Complete Window



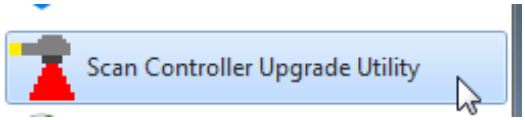
12. Click **Close** to complete installation.

Running the Scan Controller Upgrade Utility

To run the Scan Controller Upgrade Utility:

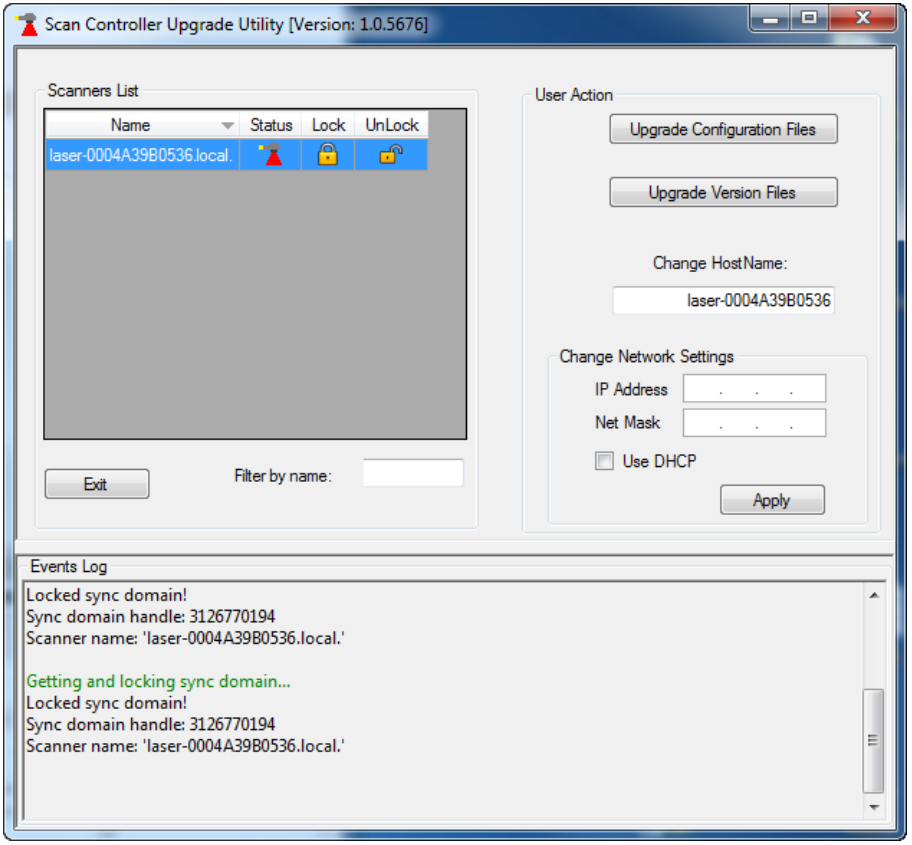
1. Select **All Programs ->Scan Controller Upgrade Utility**.

Figure 3-32. Scan Controller Upgrade Utility Program



The Scan Controller Upgrade Utility window appears as shown in Figure 3-33. The Scan Controller host name automatically appears in the Scanners List (this may take several seconds).

Figure 3-33. Scan Controller Upgrade Utility Window



2. To change the host name of the Scan Controller, enter a new name in the **Change Host Name** text box and click **Apply**. A progress status message appears in the Events Log pane.
3. To use a static IP address for the Scan Controller, enter the IP address in the **IP Address** text box and Net Mask in the **Net Mask** text box under **Change Network Settings** and click **Apply.** A progress status message appears in the Events Log pane.
4. Click **Exit** to close the Scan Controller Upgrade Utility.

WinLase 6 Quick Start

Overview

This chapter explains how to create, save, and run a one-time job using the WinLase 6 program with the Laser Marker Module, Integrated Scan Controller version.

Before you begin, ensure you have met the following requirements:

- Installed IPG ScanPack as explained in “Installing IPG ScanPack” on page 3-2.
- Installed and activated WinLase 6 as explained in “Installing the WinLase 6 Software” on page 3-9 and “Activating WinLase 6” on page 3-15.
- Configured a local area network as explained in “Configuring a DHCP IP Address” on page 3-20.
- Have your protective eyeglasses ready to wear when operating the Laser Marker.

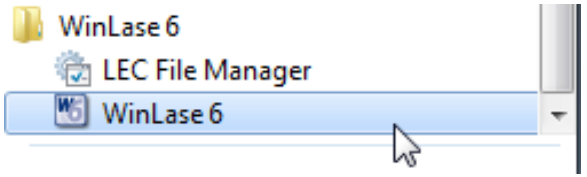
Starting WinLase 6

WinLase 6 provides drawings tools for creating custom images. You can also import file formats, for example, dxf,.bmp, and.hpgl formats.

To start the WinLase 6 program:

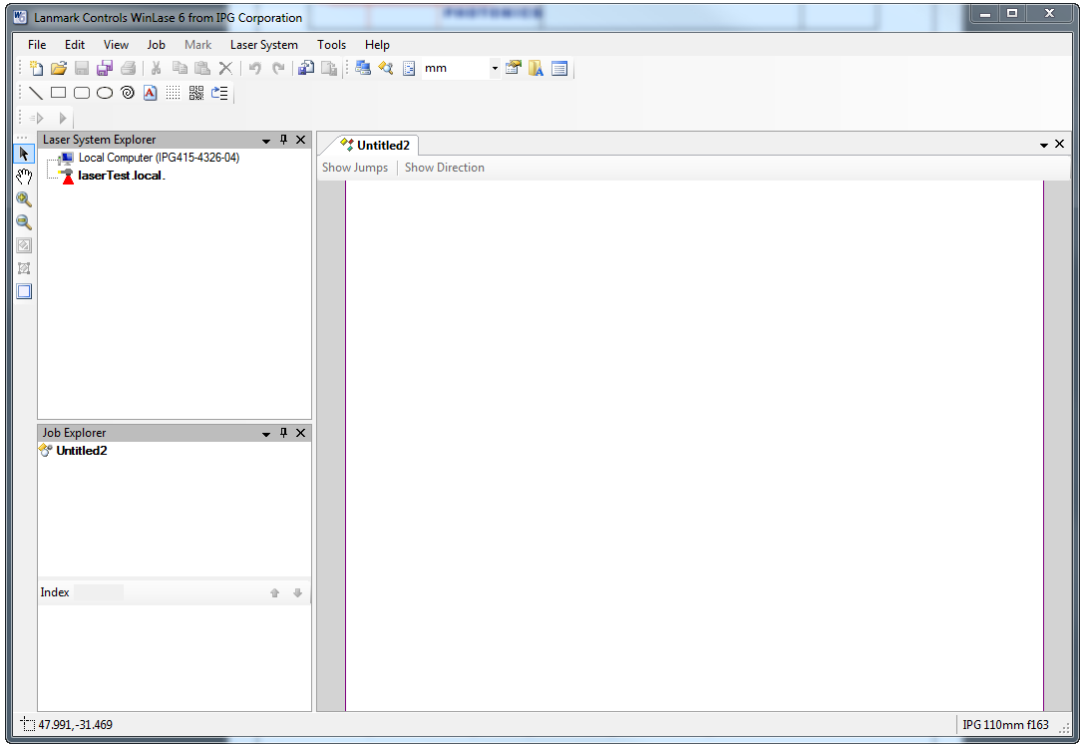
1. Go to **All Programs ->WinLase 6 folder**.
2. Select **WinLase 6.**

Figure 4-1. WinLase 6 Program



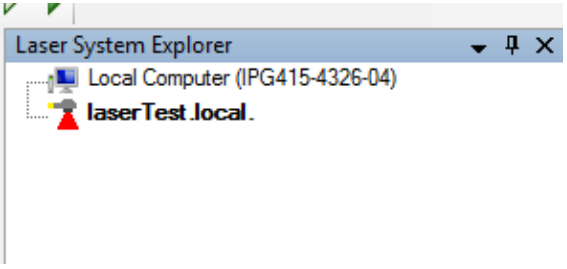
The Job Editor Workspace appears as shown in Figure 4-2. The Job Editor Workspace provides editing functions and full control sets.

Figure 4-2. Job Editor Workspace



The Laser Marker Module is automatically detected and appears in the Laser System Explorer window (this may take several seconds).

Figure 4-3. Laser System Explorer Window



3. See “Creating a Job” to continue.

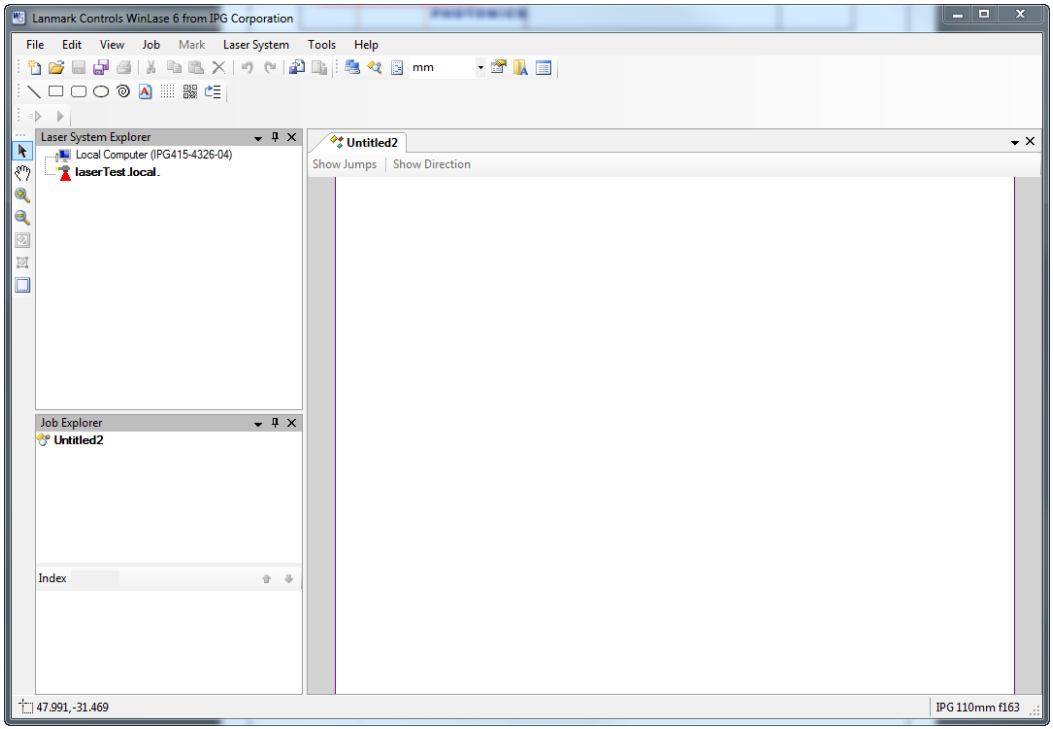
Creating a Job

This section explains how to create a job and interact with objects within this job. A job lets you assemble a series of objects that are marked on the material using the scan head.

To create a job:

1. Select **New Job** from the **File** menu. An unsaved and untitled job appears as shown in Figure 4-4.

Figure 4-4. New Job Window



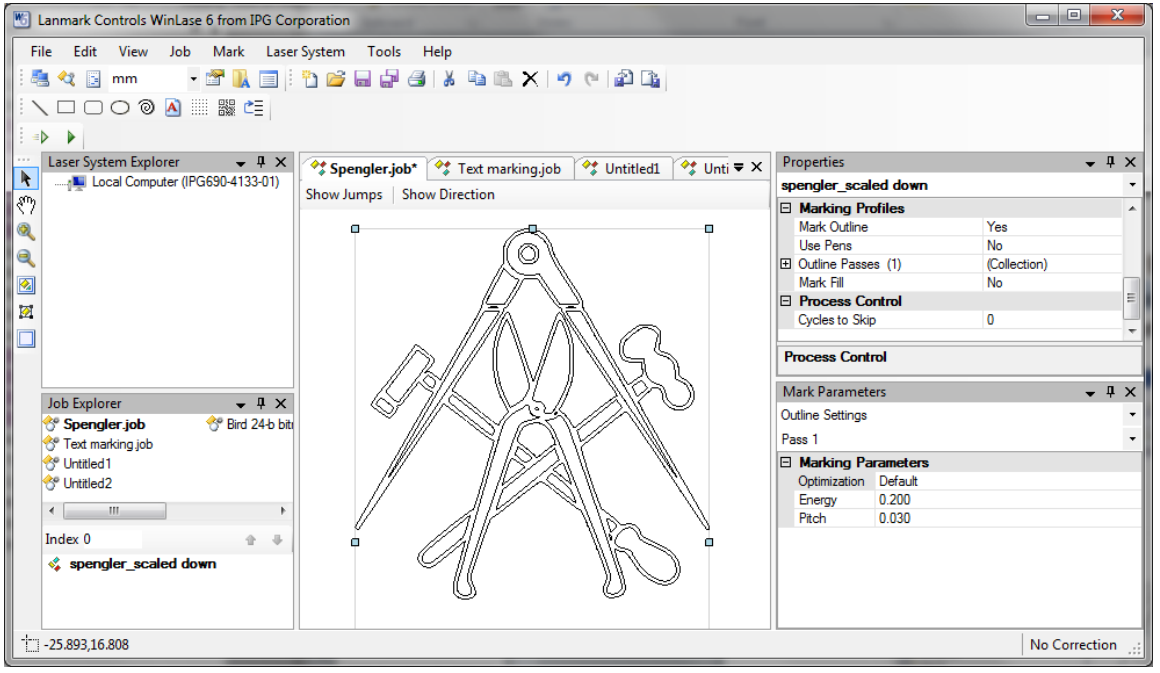
2. Define the marking layout by selecting the objects you want to mark. You can add a variety of objects such as text, barcodes, and point arrays. You can also import images by selecting **Import...** from the **File** menu. Figure 4-4 shows an example job.

3. Select **Properties Window** from the **View** menu to display the Properties window in the Job Editor Workspace. Drag the window the right side of the workspace. Make configuration changes in the Properties window if needed.

4. Select **Mark Parameters** from the **View** menu to display the Mark Parameters window in the Job Editor Workspace. Drag the window the right side of the workspace. See “Configuring Marking Parameters” on page 4-6 for a recommended marking parameter configuration.

   An example of a job with the Properties and Mark Parameters windows displayed is shown in Figure 4-5.

Figure 4-5. Example of a Job



The order in which the objects appear in the Index window is the order in which they mark when you run the job.

Configuring Marking Parameters

The following marking controls are available in the Marking Parameters window:

- **Optimization** — lets you adjust the speed or quality of the marking job.
- **Pulse Energy** — lets you adjust the energy per laser pulse. The adjustment range is 0 to 0.1 mJ.
- **Pitch** — lets you adjust the overlapping of the pulses on the laser marking area. This marking parameter lets you modify the contrast of the marking or to create various dot patterns in the engraving (for example, continuous line vs. perforated line).

For a 163mm lens, you can use the following settings for obtaining good results on most metals:

1. Set the Pitch parameter to 0.020mm.
2. Set the Pulse Energy parameter to 0.5mJ.
3. Leave the Optimization parameter as “Default.”

Note

For Bitmaps, the pitch is inherited from the output resolution and is set to approximately the spot size.

Quality optimization is automatically be invoked if limited by Laser Power. Setting the Pulse Energy to higher than needed can slow performance. Optimal Pulse Energies and spot sizes change with focal length selection.

Figure 4-6 on page 4-7 illustrates the marking parameters configuration options.

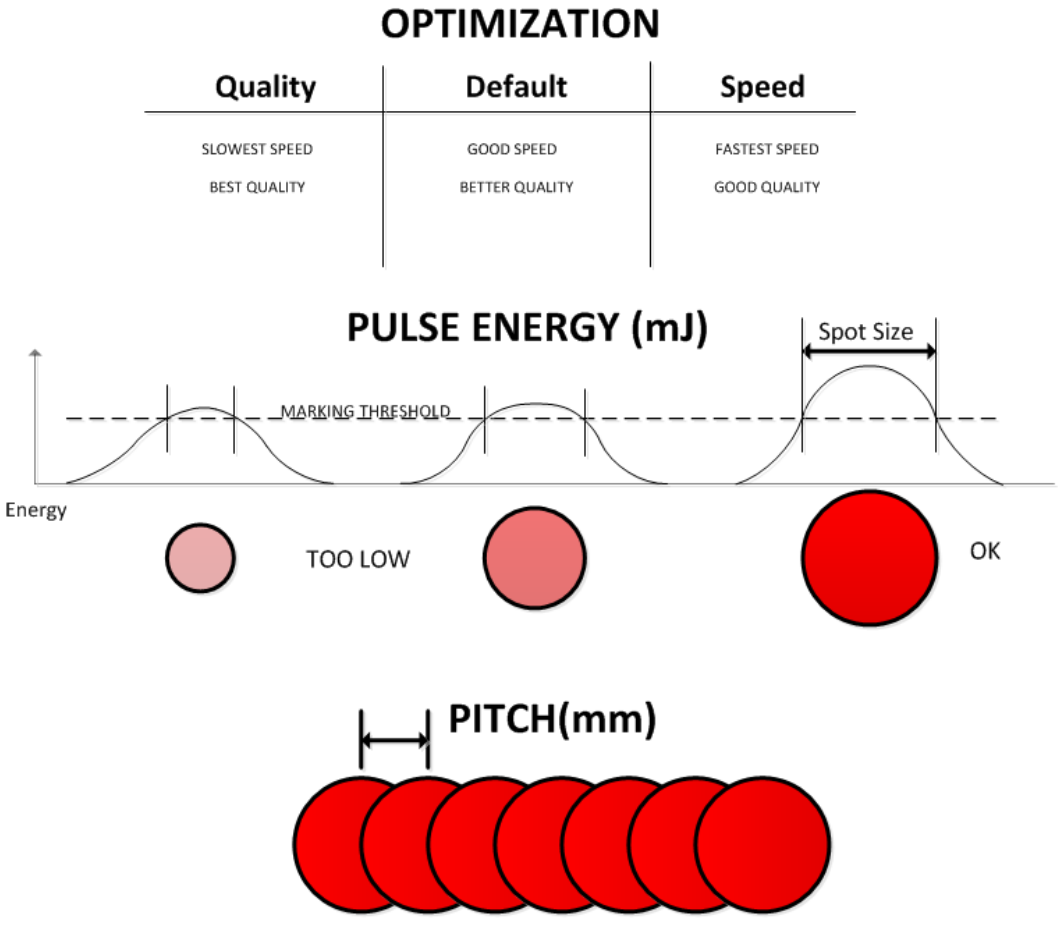
Saving a Job

The job file contains the basis for all interaction with the Laser Marker Module.

To save a job:

1. Select **Save Job** from the **File** menu.
2. Select a location for the saved job.
3. Enter the name your want for the job in the File name box.
4. Click **Save.**

Figure 4-6. Marking Parameters Configurations

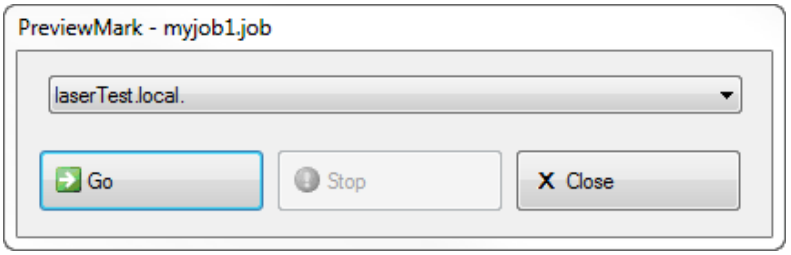


Previewing a Job

To preview a job:

1. Select **Preview Mark...** from the **Mark** menu to preview the job and align where you want to mark to appear on the targeted surface.

Figure 4-7. Preview Mark Dialog Box



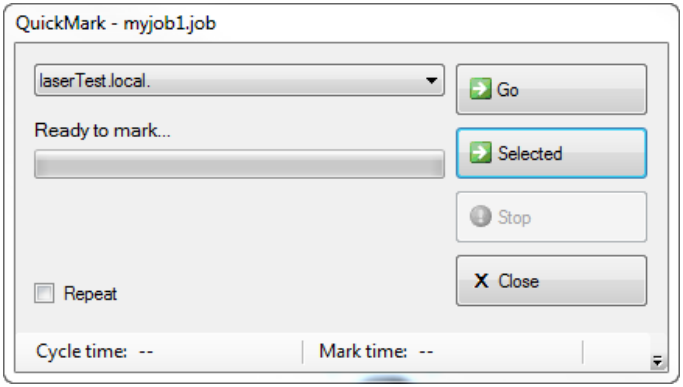
2. Click **Go**.

Running a One-Time Job

To run a one-time job:

1. Power on the Laser Marker Module.
2. Position the material to be marked on the targeted surface base.
3. Select an object or group of objects in the workspace to be marked using the arrow tool. The object appears with anchor points around it to indicate selection. The name of the object is bolded in the Index window.
4. Select **QuickMark...** from the **Mark** menu to preview the job and align where you want to mark to appear.
5. Click **Selected** to mark a single object or **Go** to mark all objects currently in the job.

Figure 4-8. QuickMark Dialog Box



6. Click **Go**. A progress bar is displayed indicating the status of the job. The optical scanner head draws the shape over the targeted surface.
7. When the marking is complete, the status bar at the bottom of the dialog box displays the mark time.

Computer Interface/Commands —XY2-100 Version

RS-232 Configuration

A three-wire (RxD, TxD, GND) interface is used (null modem cable). The individual commands are described in Table 5-2 on page 5-2.

The RS-232 interface is configured with the following parameters:

Table 5-1. RS-232 Parameters

Parameter	Value
Baud Rate	57,600
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	None

RS-232 Command Codes

The command code is a decimal ASCII representation of a number individual for each command. The list of command numbers is shown in Table 6.

Command parameter is a text string. If the parameter is a numerical value, it should be converted into a decimal ASCII string.

The returned value is also a text string. If the requested value is numerical, the opposite conversion from text string to the numerical value is required.

All commands should be terminated by carriage return symbol, hexadecimal value ”0x0D.” The RS-232 buffer of the laser receives bytes until the CR symbol occurs. All bytes before this symbol are interpreted as a command. Bytes after CR until next CR is interpreted as a next command.

For all “set” commands device returns as the parameter “Y” if the command was successfully executed and “N” if the command was not executed.

For all strings sent to the laser, which were not recognized as valid commands, the laser sends “E” as parameter. In case an option is not applicable for a particular laser the command could answer “E.”

Table 5-2. RS-232 Command Codes: Laser Monitoring and Configuration

Type	Command	Command Code	Parameters or Return Values	Description/Parameters
Read	Device ID	1	string, up to 64 characters	Read device identifier written to the laser in the factory.
Read	Device SN	2	string, up to 24 characters	Read device serial number.
Read	FW revision	3	string, up to 255 characters	Read device firmware revision.
Read	Vendor	99	string, up to 255 characters	Read device vendor written to the laser in the factory.
Read	Device Status	4	string, up to 32 characters	Read device status, decimal to binary decoding is required.
Read	Device Temperature	5	float, 1 digit after point	Read module temperature in degree celsius.
Read	Digital interface Status	10	up to 32 bit integer	Reads digital interface status, decimal to binary decoding is required.
Read	Extended Status	11	up to 32 bit integer	Read device extended status, decimal to binary decoding is required.
Read	BR Counter	12	up to 32 bit integer	Read back reflection counter.
Read	Session BR Counter	13	up to 32 bit integer	Read back reflection counter for the current session. The session starts with supplying voltage to the laser module.
Read	Nominal average Power	14	float, 1 digit after point	Read nominal average power of the laser in [W] Return value is float in [W].
Read	Nominal Pulse Duration	15	float, up to 6 digits after point	Read nominal pulse duration of the laser [ns].
Read	Nominal Pulse Energy	16	float, 1 digit after point	Read nominal peak power of the laser in [kW]. Value is calculated from the nominal energy and the nominal pulse duration.
Read	Nominal Peak Power	17	float, 1 digit after point	Read nominal peak power of the laser in [kW]. Value is calculated from the nominal energy and the nominal pulse duration.

Type	Command	Command Code	Parameters or Return Values	Description/Parameters
Read	PRR Range	18		Read pulse repetition rates range. Return value is two floats separated by a semicolon, corresponding to minimum and maximum PRR [kHz].
Read	Head Temperature	19	float, 1 digit after point	Read remote head temperature in degree Celsius, if the head is installed.
Read	Main Supply Voltage	21	float, 1 digit after point	Read main 24V supply voltage in [V].
Read	24V Housekeeping Voltage	22	float, 1 digit after point	Read 24V housekeeping supply voltage in [V].
Read	Operating Mode	23	32-bit integer	Read active control interface operating mode, decimal to binary decoding is required.
Read	Operating Mode	24	32-bit integer	Set active control interface operating mode, binary to decimal encoding is required. The command parameter is validated before the execution. If some bits are not correct, the command is not executed. All 32 bits (even unused) should have correct values. To set correctly all bits, the existing operating mode should be read by the command 24. Only necessary bits should be updated and then new value sent to the device.
Read	Installed Options	25	32-bit integer	Read list of installed options and operating modes. Decimal to binary decoding is required.
Read	Start Operating Mode	27	32-bit integer	Read control interface operating mode, which activates after connecting the laser to the supply voltage. The value is stored permanently in the laser EEPROM. Decimal to binary decoding is required.
Read	Operating Power [W]	33	float, 2 digit after point	Read back operating power in [W] set by command 32 (in RS-232 mode) or via digital interface (in DB-25 mode). Recalculated into Watts using nominal laser parameters.
Read	Operating Power [%]	34	float, 2 digit after point	Read back operating power in [%] set by command 32 (in RS-232 mode) or via digital interface (in DB-25 mode). Recalculated into [%] using nominal laser parameters.
Read	Operating Pulse Energy	36	float, 2 digit after point	Read operating pulse energy in [mJ]. Value is calculated using nominal laser parameters and power settings.

Type	Command	Command Code	Parameters or Return Values	Description/Parameters
Read	PRR monitor	38	float, 1 digit after point	Read back operating PRR in [kHz] set by command 28 (in RS-232 mode) or applied via Sync input of digital interface (in DB-25 mode).
Read	Alarm counters	70	16-bit integer	Read alarm counters. The command contains a parameter which specifies the alarm counter: 1 - 24V main supply 2 - 24V housekeeping supply 3 - System 4 -Temperature 5 -Head Temperature
Read	Module Temperature range	58	float, 1 digit after point	Read operating temperature range. Return value is two floats separated by a semicolon, corresponding to minimum and maximum temperatures in degree Celsius.
Read	Nominal frequency	59	float, 1 digit after point	Read back nominal PRR in [kHz].
Read	Critical error counter	95	16-bit integer	Read critical error counter.
Read	Critical error code	96	32-bit integer	Read critical error code.
Set	Reset critical error alarms	97	32-bit integer	Reset the critical error. The command contains one parameter, which is a one-time use code generated in IPG factory. If the correct code is sent to the device, the command is executed with answer “Y” and the critical error is cleared.

Table 5-3. RS-232 Command Codes: Control Interface

Type	Command	Command Code	Parameters or Return Values	Description/Parameters	Equivalent DB-25 Control Line
Set	Set PRR	28	float, 1 digit after point	Set operating pulse repetition rate in [kHz].	Sync
Read	Read PRR	29	float, 1 digit after point	Read back operating pulse repetition rate in [kHz] set by command 28.	EM
Set	Laser Emission ON	30		Switch ON laser emission.	EM

Type	Command	Command Code	Parameters or Return Values	Description/Parameters	Equivalent DB-25 Control Line
Set	Laser Emission OFF	31		Switch OFF laser emission.	EM
Set	Operating Power	32	float, 1 digit after point	Set operating power in [%]. Range 0…100, resolution 255 levels for the full scale.	D0-D7 and Latch
Set	Guide Laser ON	40		Switch ON guide laser.	RG
Set	Guide Laser OFF	41		Switch OFF guide laser.	RG
Set	EE ON	42		Switch ON Emission Enable.	EE
Set	EE OFF	43		Switch OFF Emission Enable	EE
Set	Reset Alarms	50		Reset alarms	Reset Sequence

Table 5-4. Commands for Adjustable Pulse Duration (ADP) Mode

Type	Command	Command Code	Parameters or Return Values	Description/Parameters
Read	Read the number of APD modes.	55	16-bit integer	Read number of APD modes (N).
Read	Read APD mode description.	56	Parameter: M Answer: string, up to 128 characters	Read a text description of APD mode with index M. Parameter is M is APD mode index, integer, range 0 to N-1. N is number of APD modes read by command $55.
Read	Read APD mode index.	68	16-bit integer	Read current APD mode index.
Set	Set APD mode index.	69	1- bit integer	Set APD mode index.
Set	Save APD mode index.	54		Permanently save the APD mode index to EEPROM. Next start the device is initialized by the saved APD mode index.

Table 5-5. Commands for Manual Rising Time Compensation (Manual Pre-Pump) Model

Type	Command	Command Code	Parameters or Return Values	Description/Parameters
Read	Maximum Pre-pump	63	16-bit integer	Return maximum value of the pre-pump compensation. The value is always 10000.
Set	Pre-Pump	64	16-bit integer	Set the pre-pump compensation value. Range is 0…10000.
Read		65	16-bit integer	Read back value of the pre-pump compensation set by command $64 or through DB-25 serial interface.

Table 5-6. Commands "$4" "Read Device Status" - Return Value Description

Bit	State	Description
0	1 0	Rack reflection Alarm active No BR alarm
1	1 0	Temperature Alarm active. Laser module temperature is out of specified range. No temperature alarm
2	1 0	System Alarm active No system alarm
3	1 0	System Alarm active No system alarm
4	1 0	+24V main supply Alarm active. Over-voltage or under-voltage of the main electrical supply occurred during the laser emission. No supply alarm
5	1 0	HK supply Alarm active. Overvoltage or Undervoltage of the 24V housekeeping electrical supply occurred during the laser emission. No supply alarm
6	1 0	Laser is ready for emission Laser is not ready for emission
7	1 0	At least one of the warnings is activated No warning is activated
8-31	1 0	Reserved

Table 5-7. Commands "$10" "Read Digital Interface DB-25 Status" - Return Value Interpretation

Bit	DB-25 Control Line	Description of Line/Data
0	Latched D0	D0 latched power setting
1	Latched D1	D1 latched power setting
2	Latched D2	D2 latched power setting
3	Latched D3	D3 latched power setting
4	Latched D4	D4 latched power setting
5	Latched D5	D5 latched power setting
6	Latched D6	D6 latched power setting
7	Latched D7	D7 latched power setting
8	D0	D0 power setting
9	D1	D1 power setting
10	D2	D2 power setting
11	D3	D3 power setting
12	D4	D4 power setting
13	D5	D5 power setting
14	D6	D6 power setting
15	D7	D7 power setting
16	Latch	
17	AuxOFF	Auxiliary Emission OFF
18	EM	Emission Modulation
19	RG	Guide laser control
20	Sync	External Synchronization Input
21	EE	Emission enable
22	Serial Input	
23	Serial Clock	
24	State1	
25	State2	

Bit	DB-25 Control Line	Description of Line/Data
26	State0	
27	Serial Output	
28	Serial Enable	
29	Reserved	Bit is reserved for future use.
30	Reserved	Bit is reserved for future use.
31	Reserved	Bit is reserved for future use.

Return bits reflect status of the corresponding pins or internal data.

"1" means that the pin/data is HIGH.

"0" means that the pin/data is LOW.

Table 5-8. Commands "$11" "Read Device Extended Status" - Return Value Interpretation

Bit	State	Description	Message Type
0	1 0	Emergency stop was activated. Emergency stop was not activated.	Warning
1	1 0	External PRR at Sync line is above specification. Not above specification.	Warning
2	1 0	External PRR at Sync line is below specification. Not below specification.	Warning
3		Reserved	
4		Reserved	
5	1 0	Guide laser was activated. Guide laser was not activated.	Warning
6		Reserved	
7		Reserved	
8	1 0	Laser emission is ON (laser is pumped). Laser emission is OFF (laser is not pumped).	Information
9		Reserved	
10		Reserved	

Bit	State	Description	Message Type
11	1 0	Laser emission ON command was received by RS-232. Laser emission OFF command was received by RS-232. This bit is valid in RS-232 control mode only.	Information
12	1 0	Guide laser ON command was received by RS-232. Guide laser OFF command was received by RS-232. This bit is valid in RS-232 control mode only.	Information
13	1 0	24V Main supply voltage is in specified range. 24V Main supply voltage is not in specified range.	Warning
14	1 0	HK supply voltage is in specified range. HK supply voltage is not in specified range.	Warning/Information
15	1 0	Emission Enable is switched ON by RS-232. Emission Enable is switched OFF by RS-232.	Warning/Information
16-31		Reserved	

Integration with a Motor or Gantry System

Overview

The Scan Controller Motor Interface allows the Laser Marker Module to work with common types of motor drivers, such as a Gantry overhead lift structure. It can be configured to send controller commands or monitor encoder feedback.

Installing the Stage Configuration Utility

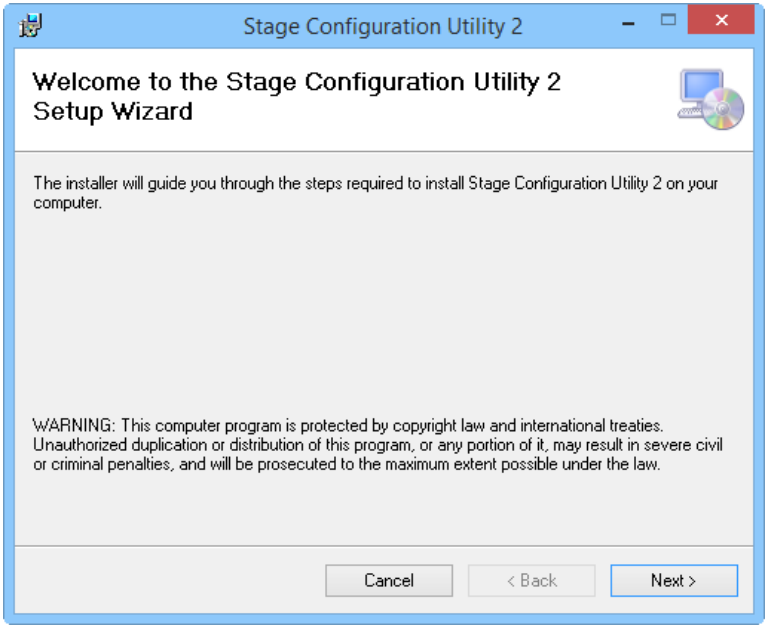
To install the Stage Configuration Utility:

1. Open a web browser and go to:

   software.ipgphotonics.com

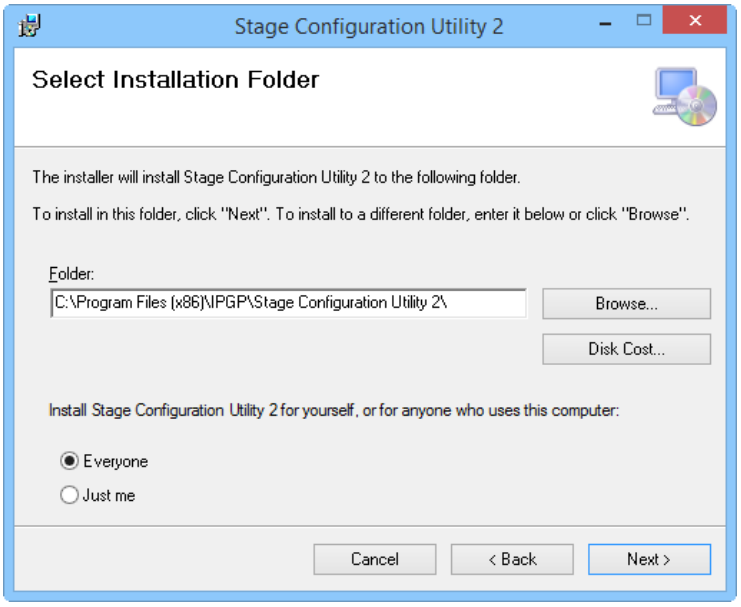
2. Click the Welder folder.
3. Click the IPGWeld folder.
4. Download the installation program zip file to your computer.
5. Once downloaded, extract the zip file. A folder is created.
6. Open the folder and run **setup.exe**. The Setup Wizard appears as shown in Figure 6-1.

Figure 6-1. Setup Wizard



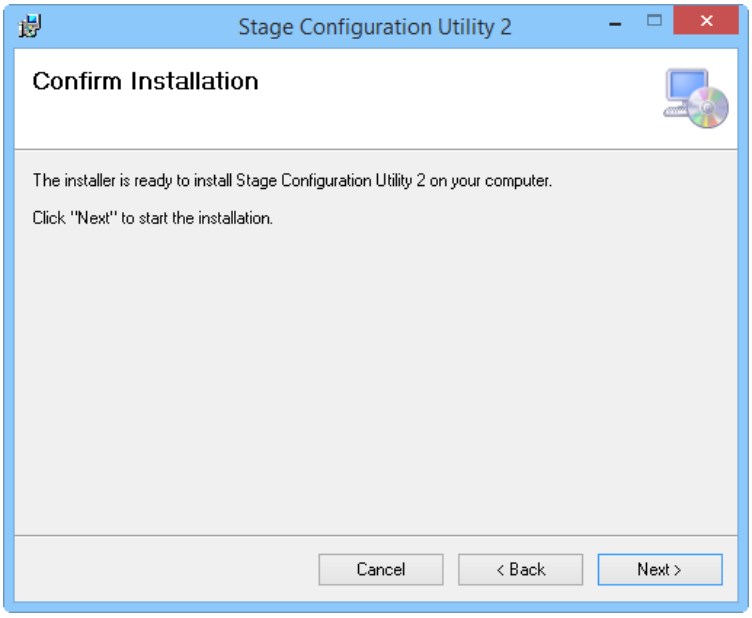
7. Click **Next.** The Select Installation Folder window appears as shown in Figure 6-2.

Figure 6-2. Select Installation Folder



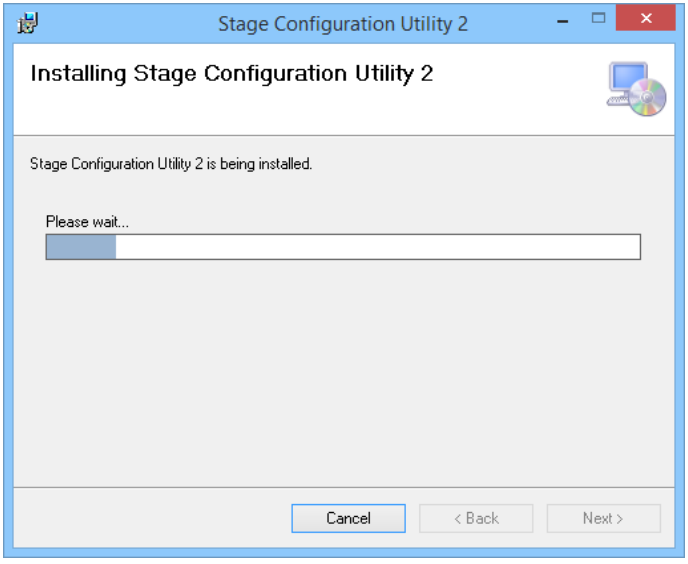
8. Click **Next** to accept the default Start Menu folder.
   a. Click **Browse** if you want to change the default Start menu to another location.
   b. Click **Everyone** to allow all users to access the Stage Configuration Utility program or **Just me** if only you want access.
9. Click **Next**. The Confirm Installation window appears as shown in Figure 6-3.

Figure 6-3. Confirm Installation



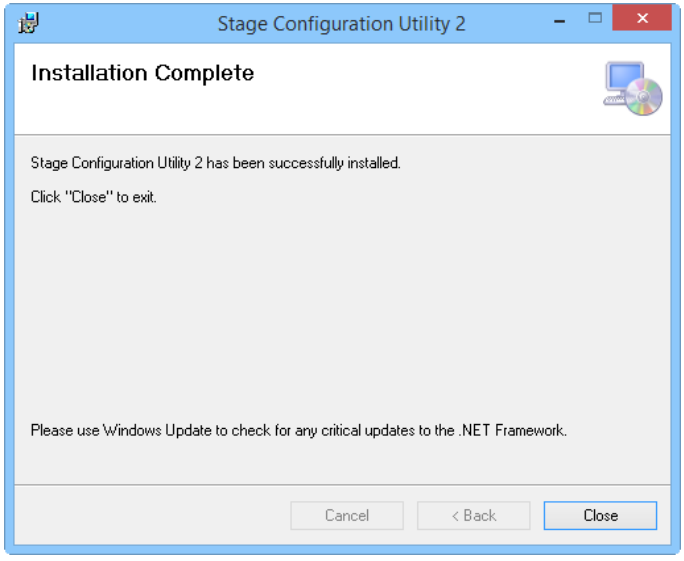
10. Click **Next** to proceed. The Installing Stage Configuration Utility window appears as shown in Figure 6-4.

Figure 6-4. Installing Stage Configuration Utility



11. Once installation is complete, the Installation Complete window appears as shown in Figure 6-5.

Figure 6-5. Installation Complete



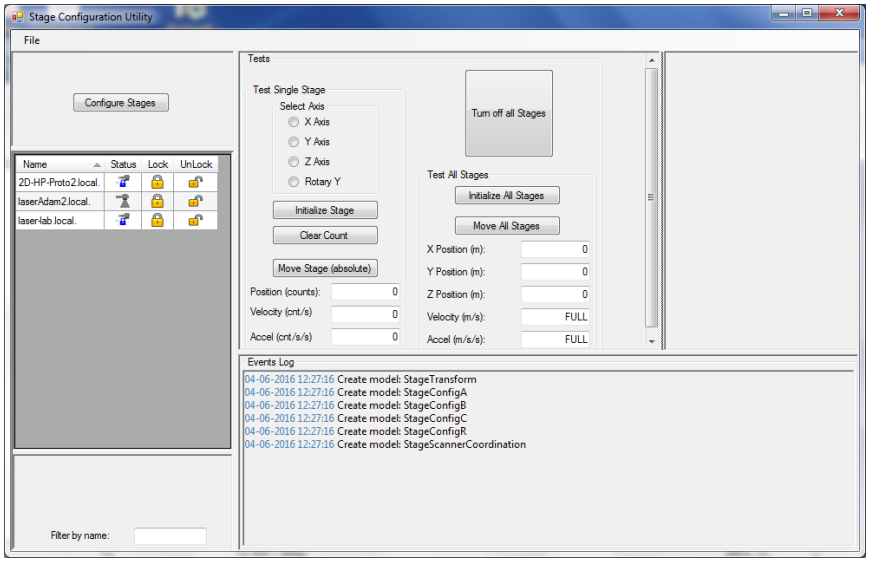
12. Click **Close** to exit the window. The Stage Configuration Utility is successfully installed on your system.

Running the Stage Configuration Utility

To run the Stage Configuration Utility:

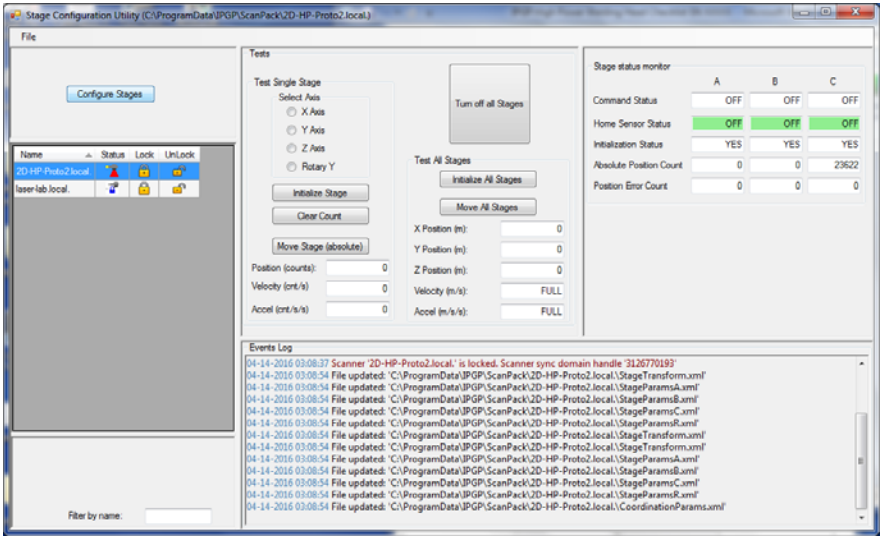
1. Open the Stage Configuration Utility program.The main window appears as shown in Figure 6-6.

Figure 6-6. Stage Configuration Utility Main Window



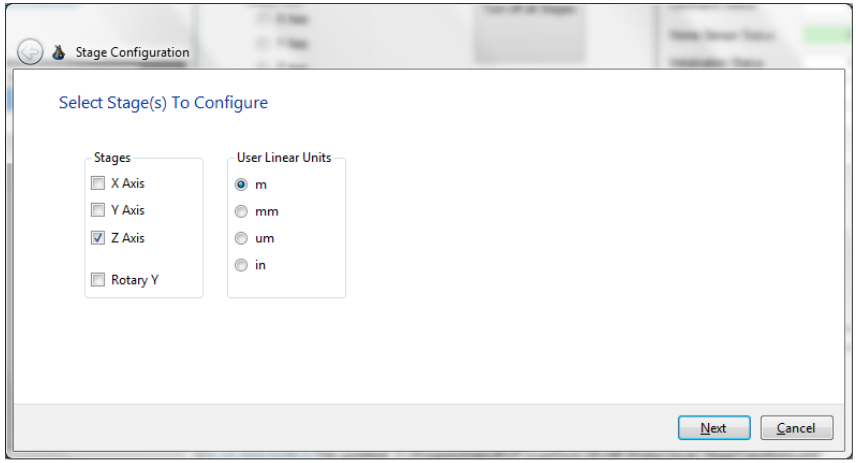
2. Select a controller from the list in the left pane. The controller you select changes to locked mode (red) as shown in Figure 6-7.

Figure 6-7. Selecting a Controller



3. Click **Configure Stages**.

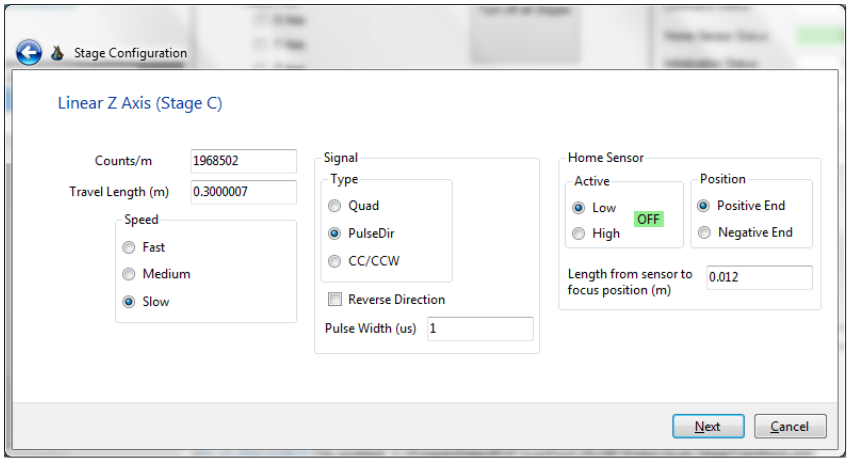
Figure 6-8. Stage Configuration



4. Select a stage, such as Z Axis.
5. Select a linear unit.

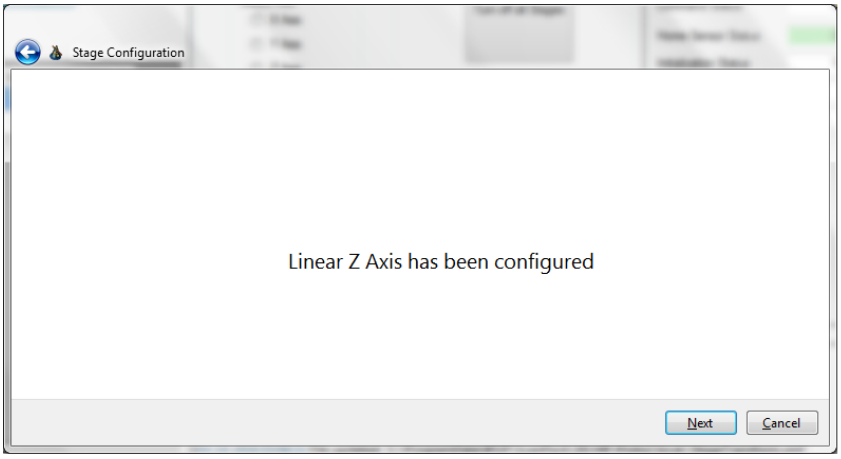
6. Click **Next**.
7. Select the stage configuration options as shown in Figure 6-9.

Figure 6-9. Linear Z Axis (Stage C)



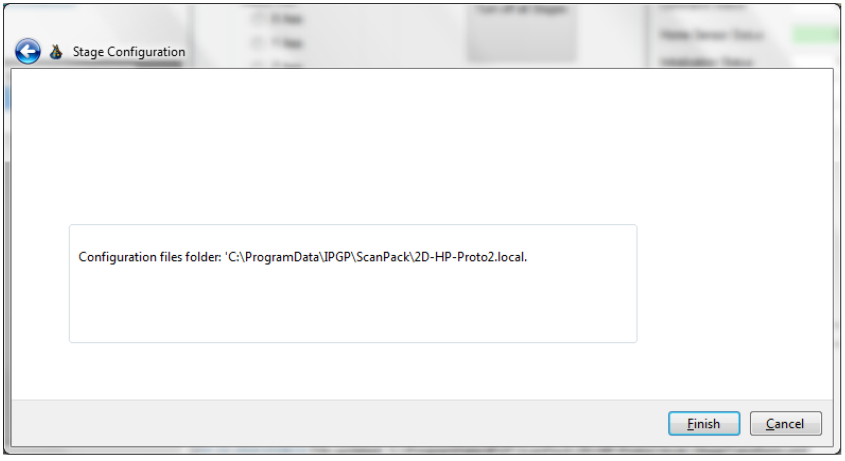
8. Click **Next**. A confirmation message appears as shown in Figure 6-10.

Figure 6-10. Confirmation Message



9. Click **Next**. A window appears displaying the local path for the configuration file.

Figure 6-11. Stage Configuration - Finish Message



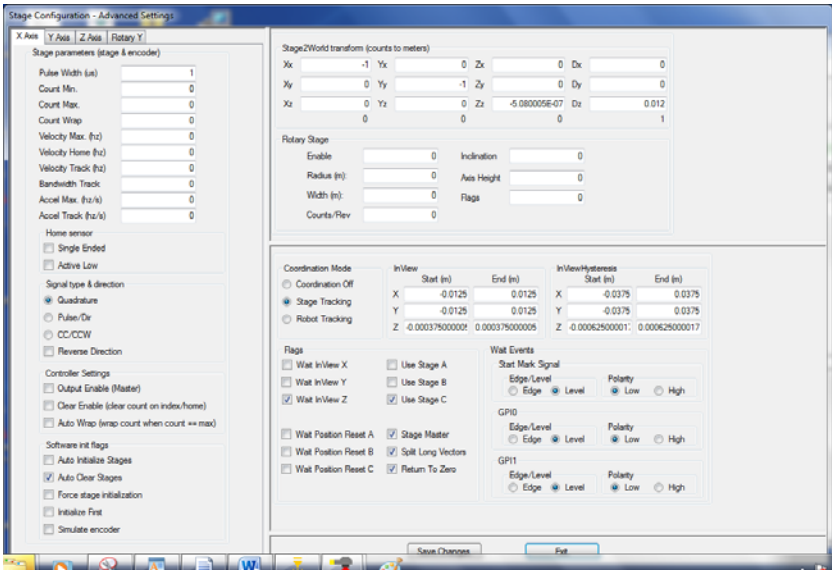
10. Click **Finish**.

Advanced Settings

To modify advanced settings:

1. Click **File->Advanced Settings**. The Advanced Settings window appears as shown in Figure 6-12.

Figure 6-12. Advanced Settings



2. Make necessary changes and click **Save Changes**.

Configuring the Motor Control Interface

The Motor Control interface allows the Laser Marker Module to control or listen to common types of motor drivers. It is connected to the 37-pin connector on the controller box.

Figure 6-13 shows the Motor Control Interface front view.

Figure 6-13. Motor Control Interface — Front View

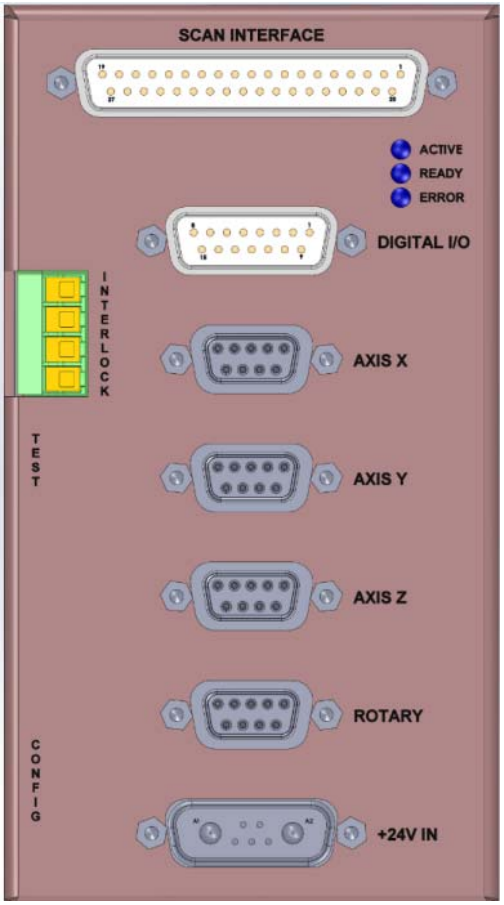


Table 6-1 on page 6-12 provides details on each component.

Table 6-1. Motor Control Interfaces Descriptions

Item	Component	Description
1	Power Supply +24V IN	+24V power supply for board. It is isolated from the 5V output supply and 3V input supply.
2	Scan Interface - 37-pin Female Sockets	Used for external interface to the 37-pin Male interface on the controller box rear panel. See“Controller Box Rear Panel View — High-Power Scanner” on page 2-12 or more information.
3	Digital I/O - Female DB15	The digital I/O is a 15-pin female interface that connect to the 37-pin interface and is isolated and at 5V logic levels.
4	Motor Controller I/O - P1, P2, P3 (Axis X, Y, Z)	This connector interfaces with a motor controller to drive a stage. There are three connectors with identical pinouts intended for XYZ control. The connectors can be configured to drive or receive signals at 5V logic and can be single-end or differential.
5	Motor Control Inputs - Female DB9	This connector is multiplexed with P2 Y axis. Depending on the logic level of P4-4 (normally high), you can enable the use of P2's signals or P4's. The Y axis signals or the Rotary axis signals are mutually exclusive. The Y axis is enabled normally; pulling P4-4 to GND enables the Rotary axis and disable the Y axis.
6	Fiber Interlock	Brings the fiber interlock signals from the scan controller out to screw taps.

Scan Interface — 37-Pin Sockets

Figure 6-14 illustrates the Scan Controller 37-pin female sockets.

Figure 6-14. 37-Pin Sockets

Table 6-2 provides details for the 37-pin sockets.

Table 6-2. 37-Pin Descriptions

Pin	Name	I/O	Description
1	Active	Out	Mark in Progress
20	GND	3VTTL	
2	Ready	Out	Ready/Waiting Signal
21	GND	3VTTL	
3	Error	Out	Error Condition
22	GND	3VTTL	
4	Start	In	Start Signal Input
23	GND	3VTTL	Pulled up to 3.3V
5	Stop	In	Stop Signal Input Active Low
24	GND	3VTTL	Pulled up to 3.3V
6	GPIO[0]	In/Out	General Purpose Input/Output for Synchronization
25	GND	3VVTL	Pulled up to 3.3V
7	GPIO[1]	In/Out	General Purpose Input/Output for Synchronization
26	GND	3VVTL	Pulled up to #.3V
8	A_Axis_A+	In/Out	Axis A Phase A
27	A_Axis_A-	RS-422	

9	A_Axis_B+	In/Out	Axis A Phase B
28	A_Axis_B-	RS-422	
10	A_Axis_Z+	In	Axis A Phase Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V)
29	A_Axis_Z-	RS-422	
11	B_Axis_A+	In/Out	Axis B Phase A
30	B_Axis_A-	RS-422	
12	B_Axis_B+	In/Out	Axis B Phase B
31	B_Axis_B-	RS-422	
13	B_Axis_Z+	In	Axis B Phase Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V)
32	B_Axis_Z-	RS-422 or 3VTTL	
14	C_Axis_A+	In/Out	Axis C Phase A
33	C_Axis_A-	RS-422	
15	C_Axis_B+	In/Out	Axis C Phase B
34	C_Axis_B-	RS-422	
16	C_Axis_Z+	In/Out	Axis C Home (or Zero) Differential or Single Ended (on Z+ Pulled up to 3.3V) or ClkIn/ClkOut Differential for Synchronization to laser.
35	C_Axis_Z-	RS-422 or 3VTTL	
17	FiberInterlockA0	Out Relay	FiberInterlock is safe when 1 is connected to 0.
36	FiberInterlockA1		
18	FiberInterlockB0	Out Relay	FiberInterlock is safe when 1 is connected to 0.
37	FiberInterlockB1		
19	GND	Out	Logic Ground

Digital I/O — 15-Pin Sockets

Figure 6-15 illustrates the Digital I/O 15-pin female sockets.

Figure 6-15. 15-Pin Female Sockets

Table 6-3 provides details for the 9-pin female sockets.

Table 6-3. Digital I/O 15-Pin Descriptions

Socket	Name	i/O	Description
1	GND		
2	Stop	Input	Stop signal input, active low. Pulled up to +5V.
3	Ready	Output	Ready, waiting for start.
4	GPIO[0]	Input	If pin 6 on DB37 is an input use this pin. Must configure SW2-1 for input.
5	GND		
6	GPIO[1]	Output	If pin 7 on DB37 is an output use this pin. Must configure SW2-2 for output.
7	GND		
8	GND		
9	Start	Input	Start signal input. Pulled up to +5V.
10	Active	Output	Mark in progress.
11	Error	Output	Error Condition
12	GPIO[1]	Input	If pin 7 on DB37 is an input use this pin. Must configure SW2-2 for input.
13	GPIO[0]	Output	If pin 6 on DB37 is an output use this pin. Must configure SW2-2 for output.
14	GND		
15	GND		

Motor Control I/O - P1, P2, P3

Figure 6-16 illustrates the Motor Control I/O 9-pin female sockets.

Figure 6-16. 9-Pin Female Sockets

Table 6-4 provides details for the 9-pin female sockets.

Table 6-4. Motor Control I/O 9-Pin Descriptions

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

Motor Control Inputs

Figure 6-17 illustrates the Motor Control I/O 9-pin female sockets.

Figure 6-17. 9-Pin Female Sockets

Table 6-5 provides details for the 9-pin female sockets.

Table 6-5. Motor Control I/O 9-Pin Descriptions

Num	Name	i/O	Description
5	ROTARY_IN0+	IO	Can be a 5V command or encoder feedback (SE or Differential) depending on SW1.
9	ROTARY_IN0-		Only used if differential signal is needed.
4	ROTARY_SEL_L	Input	Pulled up to +5V. When this signal is high, the Y axis is enabled; when it is low the Rotary axis is enabled.
8	ROTARY_IN1+	Input	Can be a 5V command or encoder feedback (SE or Differential) depending on SW1.
3	ROTARY_IN1-		Only used if differential signal is needed.
7	GND		
2	Home_sensor+	Input	Home sensor input. Can be SE or differential depending on SW1.
6	Home_sensor-	Input	Only used if differential signal is needed.
1	GND		

Fiber Interlock Inputs

Figure 6-18 illustrates the Fiber Interlock pin female sockets.

Figure 6-18. 9-Pin Female Sockets

Table 6-6 provides details for the 9-pin female sockets.

Table 6-6. Motor Control I/O 9-Pin Descriptions

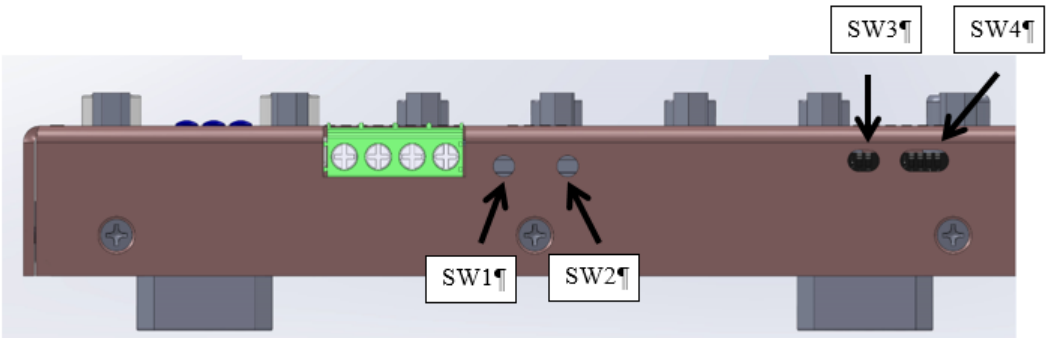
Num	Name	i/O	Description
1	INTLK_A0	Out	Fiber Interlock is Safe when 1 connected to 0.
2	INTLK_A1		
3	INTLK_B0	Out	Fiber Interlock is Safe when 1 connected to 0
4	INTLK_B1		

PCB Configuration and Testing

There are two sets of dip switches used to configure the board. Two momentary contact push buttons can also test the operation of the "Start" and "Stop" commands.

Figure 6-20 shows the Motor Control Interface side view.

Figure 6-19. Motor Control Interface - Side View



SW1 and SW2 - Pushbutton Test Signals

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

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

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

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

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

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

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

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

SW4 - Encoder Interface Setup - SW4

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

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

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

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

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

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

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

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

Position 4 - Reserved

Maintenance

Overview

The Laser Marker Module is incorporated into a given fixed installation. The safety functions have to 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 Laser Marker Module is installed.

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

Service

Service and Repairs

Refer all servicing to qualified IPG Customer Service personnel.

Many issues and questions regarding the safety, set-up, operation and maintenance of the IPG products can be resolved by reading this user's guide. However, if you have questions regarding the safety, set-up, operation or maintenance of your IPG product, call the IPG Photonics Customer Service department.

If you cannot resolve the issues by using this guide or over the telephone with our technical support group, you might need to return the product to IPG. See “Product Returns” on page D-1 for more details.

Warranty

Limited Express Product Warranties

IPG warrants to the original Buyer or, if Buyer is an authorized IPG reseller or distributor, to Buyer's original customer of the IPG Product, that the IPG Product conforms to applicable IPG Product specifications and is free from defects in materials and workmanship. These non-transferable warranties start on the shipment date from IPG (or other date specifically referencing the warranty start date in IPG's sales order/order acknowledgement), and continue until the end of the warranty period listed in IPG's sales order/order acknowledgement. If there is no warranty period listed, then warranty period is one year. Products or major components manufactured by parties other than IPG bear the original manufacturer's warranty and warranty period. The obligations of IPG are limited to the repair or replacement (at IPG's option) of any Product that does not meet the IPG warranty during the warranty period. IPG warrants repaired or replaced Products under warranty only for the remaining un-expired period of time in the original warranty. IPG reserves the right to issue a credit note for any defective Products that have proved defective through normal usage; Buyer debit memos are not allowed. This warranty governs over any conflicting terms in Buyer's purchase order or other IPG documents except as expressly provided herein.

Warranty Limitations

This warranty excludes and does not cover defects or damage resulting from any of the following: contamination of external optical surfaces; unauthorized modification, misuse or mishandling, disassembly or opening, neglect, or damage from accident; operation outside environmental specifications or product ratings; user software or interfacing; components and accessories manufactured by companies other than IPG, which have separate warranties; improper or inadequate installation, site preparation or maintenance; or failure to follow information and precautions contained in the operating manual. Additional warranty exceptions, limitations and exclusions may apply for laser systems manufactured by IPG and its affiliates as set forth in the applicable quotation and sales order/order acknowledgement. All products or components (including software) identified as experimental, prototypes or to be used in field trials are not warranted and are provided to the Buyer on an "as is" basis. IPG assumes no responsibility for Buyer or third-party supplied material, components, systems or equipment. Products and repaired Products may contain components that have been previously used in other

products, however such Products meet IPG Product specifications for newly manufactured Products. The Buyer must give prompt notification to IPG of any claim under the warranty in writing. IPG has no responsibility for warranty claims more than 30 days after the Buyer discovers or becomes aware of the claimed defect. Buyer is responsible for providing appropriate utilities and operating environment as stated in the operating manual and the specifications. This warranty applies only to the original Buyer at the initial installation or delivery point. Buyer must make all claims under this warranty and no claim will be accepted from any third party.

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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).
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5. Complete packing list with product model and serial number will ensure prompt repair.
6. Be sure to include with the returned product your 'ship to' address for the return of the serviced product.

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50 Old Webster Road

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Siemensstrasse 7

D-57299 Burbach, Germany

Attn: Product Returns

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Glossary

°C	Degrees centigrade or Celsius
°F	Degrees Fahrenheit
λ	Lambda (wavelength symbol)
µs	Microsecond = 10^{-6} second
Amp	Amperes
AC	Alternating current
ADC	Analog-to-digital converter
ASCII	American Standard Code for Information Interchange (U.S. Government)
BTU	British thermal unit
CAN	Controller Area Network
CDRH	Center for Devices and Radiological Health (U.S. Government)
CFR	Code of Federal Regulation (U.S. Government)
cm	Centimeters = 10^{-2} meters
CPU	Central processing unit
CW	Continuous wave (operating mode)
DC	Direct current
EN	European Norm
Hz	Hertz or cycles per second (frequency)
kg	Kilograms
kV	Kilovolts = 10^{3} volts
kW	Kilowatts = 10^{3} watts

l	Liters (volume)
lbs	Pounds
IP	Internet protocol
LD	Laser diode
LCD	Liquid crystal display
LED	Light emitting diode
nm	Nanometer = 10^{-9} meters
mA	Milliamps = 10^{-3} amperes
mm	Millimeter = 10^{-6} meters
MHz	Megahertz = 10^{6} Hertz
mrad	Milliradian = 10^{-3} radians (geometry)
rms	Root mean square or quadratic mean
QCW	Quasi-Continuous wave (operating mode)
TCP	Transmission control protocol
VAC	Voltage alternating current
VDC	Volts Direct Current
W	Watts (power)

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