FIBER LASER MARKER

LMF SERIES

OPERATION MANUAL

990-559 REV J

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Revision Record

Revision	EO	Date	Basis of Revision
A	42514	4/13	Production Release
B	42714	9/13	Update Collimator Removal Section
C	42911	11/13	Update to Miyachi America name and logo.
D	43146	4/14	Add LMF-10 Model.
E	43249	6/14	Updated schematics and certification.
F	43245	10/14	Add LEC-1 P6 Controller + AF Head Options + Vector Node Edit
G	43511	4/15	Updated to Amada Miyachi America name and logo.
H	43879	10/15	Updated to Amada Miyachi America format.
J	44289	08/16	Miscellaneous Manual updates. See body of ECO for details.

Models Covered In This Manual

Model		Nominal Power	Laser Specification
LMF70-HP	8-79-Exx-xxA	70W	High Performance, $M^2 < 1.6$
LMF50	8-79-Bxx-xxA	50W	Standard, $M^2 \leq 2.0$
LMF35-HP	8-79-Qxx-xxA	35W	High Performance, $M^2 \leq 3.5$
LMF20-HP	8-79-Rxx-xxA	20W	High Performance, $M^2 \leq 2.0$
LMF20-SM	8-79-Pxx-xxA	20W	Single Mode, $M^2 \leq 1.3$
LMF20	8-79-Cxx-xxA	20W	Standard, $M^2 \leq 2.0$
LMF10	8-79-Dxx-xxA	10W	Standard, $M^2 \leq 2.0$

Your LMF Fiber Laser Marker Shipment Contains The Following Items:

1. LMF Laser Marker and Power Supply
2. Scanner Control Cable DB25
   - 2m, Amada Miyachi America P/N 4-66138-01 (1 each LMF20-HP & LMF20-SM only)
   - 3m, Amada Miyachi America P/N 4-69398-01 (1 each all other models)
   - 5m, Amada Miyachi America P/N 4-70263-01 (1 each LM10 model only)
3. Head I/O Cable DB15
   - 2m, Amada Miyachi America P/N 4-66107-01 (1 each LMF20-HP & LMF20-SM only)
   - 3m, Amada Miyachi America P/N 4-69397-01 (1 each all other models)
   - 5m, Amada Miyachi America P/N 4-70264-01 (1 each LM10 model only)
4. Ship Kit, Amada Miyachi America Part Number 4-81221-01
   - Power Cord, CE, #14-3, Black, Amada Miyachi America P/N 205-133 (1 each)
   - Cat 5e Crossover Cable, Amada Miyachi America P/N 205-318 (1 each)
   - CD, Manuals, Amada Miyachi America P/N 4-39312-01 (1 each)
     - **i.** *Quickstart* Guide For The *WinLase* LAN Laser Marker Software, Amada Miyachi America P/N 990-550
     - **ii.** This Operator Manual For The LMF Fiber Laser Marker, Amada Miyachi America P/N 990-559
     - **iii.** Laser Safety Manual, Amada Miyachi America P/N 990-502
   - System I/O Jumper Assembly, Amada Miyachi America P/N 4-69639-01 (1 each)
   - Remote Interlock Test Jumper Assembly, Amada Miyachi America P/N 4-69640-01 (1 each)
   - Emergency Stop Test Jumper Assembly, Amada Miyachi America P/N 4-69641-01 (1 each)
   - Kit, Connectors and Backshells, I/O, Amada Miyachi America P/N 4-69642-01 (1 each)
5. Customer specified *f*-theta lens and collimator installed in the marker (where applicable)

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Chapter 6. *Marker Motion*™ Motion Control

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CONTACT US

Thank you for purchasing a Miyachi Unitek™ LMF Series Fiber Laser Marker.

Upon receipt of your equipment, please thoroughly inspect it for shipping damage prior to its installation. Should there be any damage, please immediately contact the shipping company to file a claim, and notify us at:

Amada Miyachi America
1820 South Myrtle Avenue
Monrovia, CA 91016

Telephone: **(626) 303-5676**

FAX: **(626) 358-8048**

E-Mail: **info@amadamiyachi.com**

The purpose of this manual is to provide the information required for proper and safe operation and maintenance of the Miyachi Unitek™ LMF Fiber Laser Marker.

We have made every effort to ensure that the information in this manual is both accurate and adequate. If you have any questions or suggestions to improve this manual, please contact us at the phone number or address above.

Amada Miyachi America is not responsible for any loss or injury due to improper use of this product.

SAFETY PRECAUTIONS

General

This Operator's Manual describes the Operation and Maintenance of the LMF Series Fiber Laser Marker, and provides instructions relating to its SAFE use. Procedures described in this manual ***must*** be performed as detailed by ***qualified*** and ***trained*** personnel.

For SAFETY, and to effectively take advantage of the full capabilities of the Marker, please read this instruction manual and the Laser Safety Manual (Part Number 990-502) thoroughly ***before*** attempting to use the Marker.

After reading this manual, retain it for future reference when any questions arise regarding the proper and SAFE operation of the Marker.

Operation

Follow all OSHA requirements for workplace safety. Appoint a Laser Safety Officer. The Laser Safety Officer (LSO) must provide personnel with sufficient training so that personnel can operate, maintain and service the Laser Marker safely. The LSO must take charge of the key to the Key Switch to ensure that ***only*** qualified and authorized personnel operate the Laser Marker.

Establish and control a dedicated Laser Operation Area. The Laser Safety Officer must isolate the Laser Operation Area from other work areas and display signs warning that the Laser Operation Area is off-limits to unauthorized personnel.

To prevent eye damage when operating, maintaining or servicing this equipment, laser protective goggles must be worn (per ANSI Z136.1). Laser goggles with an OD (optical density) of 7+ (at a wavelength of 1060-1150nm) are recommended or as directed by your LSO.

Maintenance/Service

Before performing any maintenance on the Marker, read *Chapter 4, Maintenance* thoroughly. Use the appropriate tools for terminating the connecting cables, being careful not to nick the wire conductors.

Procedures other than those described in this manual or not performed as prescribed in this manual, may expose personnel to electrical and/or laser radiation hazards.

Do ***not*** modify the Marker without prior written approval from Amada Miyachi America.

Before using this equipment, read the **Safety Precautions** carefully to understand the correct usage of the equipment.

- These precautions are given for the safe use of the Marker and for prevention of injury to operators or others.
- Be sure to read ***each*** of the instructions, as they are all important for safe operation.
- The meaning of the words and symbols are as follows:

CAUTION

Denotes operations and practices that may result in personal injury or damage to the equipment if not correctly followed.

WARNING

Denotes operations and practices that may result in serious injury or loss of life if not correctly followed.

DANGER

Denotes operations and practices that may imminently result in serious injury or loss of life if not correctly followed.

DANGER

	**Do *not* touch inside the Marker when it is turned ON.** Doing so may result in electric shock.
	***Never* attempt to disassemble, repair, or modify the Marker.** Doing so may result in electric shock or fire. Refrain from any mechanical adjustment other than the maintenance procedures specifically described in the operation manual.
	***Never* expose eyes or skin to laser irradiation.** Exposure to direct or scattered laser light is extremely hazardous. Direct exposure of the eye to laser beams may result in blindness.

WARNING

	**Wear protective eyewear suitable for the laser being used.** Always wear protective eyewear when using the Marker. Keep in mind that exposure of the eyes to direct laser irradiation may result in blindness, even when wearing protective eyewear.
	**Never aim the laser at any part of your own body or other people.** Exposure to laser beams will cause severe burns. Never aim the laser at yourself or at anyone else.
	**Do *not* touch workpieces during or just after marking.** Workpieces may be very hot.
	**Use only the specified cables. Make sure they are firmly connected.** Using cables of inadequate current capacity or connecting cables loosely may result in fire or electric shock.
	**Avoid damaging power or connecting cables.** Do not step on, twist, or pull cables. Damaged cables may result in electric shock, short circuits, or fires. To repair or replace cables, contact Amada Miyachi America.
	**Avoid damaging the delivery fiber.** Do not twist, kink or attempt to remove the fiber. Do not attempt to coil or bend the fiber tighter than a 4.7 inch (120mm) radius. Doing any of these actions will required factory refurbishment of the laser and will void the warranty.
	**Stop using the Marker if any problems arise.** Continuing to use the Marker in the presence of abnormalities (fumes, unusual sounds, excessive heat, smoke, and so forth) may result in electric shock or fire. In this case, immediately turn the Marker OFF and contact Amada Miyachi America.
	**Ground the Marker.** Failure to ground the Marker may result in electric shock if the Marker is damaged or if electrical leaks occur.
	**Avoid spilling or splashing water on the Marker.** The presence of water on electrical parts may result in electric shock or short circuits. Liquid spills may degrade the unit's insulation, resulting in electric leaks or fire.

CAUTION	
	**Use the appropriate tools to terminate the power cable (wire strippers, crimp tools, etc.).** Failure to use the appropriate tools may result in damage to the wire core, resulting in fire or electric shock.
	**Install the Marker on a solid, level surface.** Should the Marker tip over or fall, injury or damage to the unit may result.
	**Keep combustible materials away from the Marker.** Sparks or spattering material may ignite combustible matter. To avoid the risk of fire, never apply the laser beam to flammable or combustible materials.
	**During use, do *not* cover the Marker with a blanket, cloth, or similar articles.** When using the Marker, do ***not*** cover with a blanket, cloth, or similar articles. The Laser Marker may become extremely hot, resulting in fire.
	**Do *not* use the Marker for any purpose other than laser processing.** Using the unit for non-specified applications may result in electric shock or fire.
	**Wear protective gear.** Use protective gloves, long-sleeve garments, leather aprons, or other appropriate protective gear. Sparks or spattering material may burn the skin on contact.
	**Keep a fire extinguisher nearby.** Keep a fire extinguisher in the marking area in case of fire.
	**Maintain and inspect the unit at periodic intervals.** Maintain and inspect the unit at periodic intervals. Repair any damage before resuming use.

Guidelines for Normal Use

1. Appoint a Laser Safety Officer (LSO). Ensure that the LSO has as much expertise and experience with lasers and laser equipment as possible.

   The LSO, who will be in charge of the laser key switch, is responsible for familiarizing users with safety issues and for coordinating laser marking.

2. Partition off all areas that may be exposed to laser light.

   The LSO is responsible for posting signs to keep unauthorized personnel out of the marking area.

3. Install the Marker on a solid, level surface in a laser safe enclosure that meets all applicable safety rules, regulations, and requirements.

   To prevent errant marking, place workpieces on the same stand as the Marker Head so that the workpieces do ***not*** vibrate during marking.

4. To ensure optimal marking quality, use the Marker in a location where ambient temperatures are 41ºF to 95ºF (5°C to 35°C), free of sudden temperature fluctuations and a relative humidity less than 90% (non-condensing). Do ***not*** use the marker in any of the following locations:
   - Locations with excessive dirt, dust, oil mist, fumes, or moisture.
   - Locations in which the unit may be subject to vibration or impact
   - Locations in which the unit may be exposed to chemicals
   - Locations near sources of high-frequency noise, or
   - Locations in which condensation may form on the unit's surface.

5. If the room temperature changes quickly (as when a heater is turned ON in cold weather), moisture may condense on the optical components, resulting in fogging or collection of dust.

   Avoid sudden changes in temperature. Under the conditions in which condensation may occur, wait for a period of time after turning the unit ON before beginning operations.

6. If the exterior of the unit becomes soiled, wipe it with a soft lightly moistened or dry cloth.

   Clean heavily soiled areas with a cloth moistened with diluted neutral detergent or alcohol. Do ***not*** use paint thinner, acetone, benzene, or similar chemicals, which may discolor or damage the unit.

7. Never place screws or other foreign objects inside the marker. Such objects can damage the unit.

8. Operate the switches and buttons gently by hand.

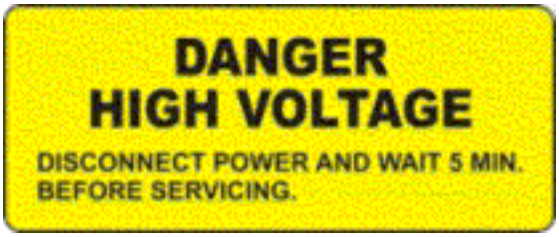
9. For more consistent marking, allow the unit to thermally stabilize for approximately 10 to 30 minutes before use. The appropriate warm-up time will depend on the ambient temperature and work piece material.

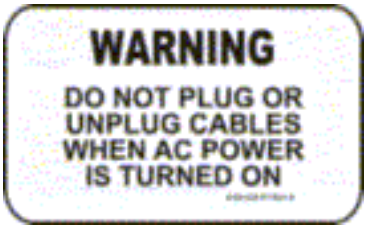
Refer to the following standards for more information on managing laser equipment:

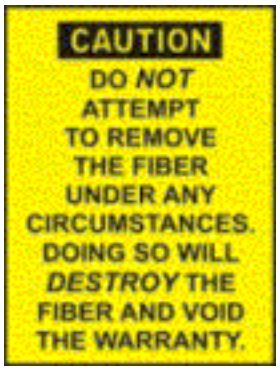
- **IEC60825-1 Edition1.2** "Safety of laser products Part1: Equipment Classifications, requirements and user's guide."
- **Amada Miyachi America Laser Safety Manual** (Part Number 990-502)

Warning Labels

The Laser Marker carries the following labels. Read and follow the label instructions to ensure correct use. Some label contents may differ based on configuration.






CAUTION
DO NOT
ATTEMPT
TO REMOVE
THE FIBER
UNDER ANY
CIRCUMSTANCES.
DOING SO WILL
DESTROY THE
FIBER AND VOID
THE WARRANTY.


EMISSION
SHUTTER
CAUTION
DON'T PLUG OR UNPLUG CABLES
WHEN AC POWER IS TURNED ON
VISIBLE AND INVISIBLE
LASER RADIATION
AVOID EYE OR SKIN
EXPOSURE TO DIRECT
OR SCATTERED RADIATION
CLASS 4 LASER PRODUCT
CAUTION-CLASS 4
LASER RADIATION WHEN
OPEN AND INTERLOCKS
DEFEATED
AVOID EYE OR SKIN
EXPOSURE TO DIRECT
OR SCATTERED RADIATION

EC Declaration of Incorporation
For Incomplete Machinery

In accordance with EN ISO 17050-1: 2004

We, Miyachi America Corporation
of 1820 S Myrtle Avenue
Monrovia, CA 91016

In accordance with the following Directive(s):

2004/108/EC **The Electromagnetic Compatibility Directive**
2006/95/EG/EC/UE **Low Voltage Directive**

hereby declare that:

Equipment Function: LMF/ML-73xxD Fiber Laser Marker
Model Number: 8-79-xxx-xxx where x is configurable per unit specification
Serial Number: See Individual Unit Label

is in conformity with the applicable requirements of the following documents

Ref No:
EN61326-1, EN61010-1, EN55011 Class A Group 1, EN61000-4-2, EN61000-4-3, EN61000-4-4, EN6100-4-5, EN61000-4-6, EN61000-4-8, EN61000-4-11

We hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications and is in accordance with the requirements of the Directive(s)

In accordance with the following Directive for the same equipment:

2006/42/EC **The Machinery Directive**

we hereby declare that the basic requirements (appendix 1) of the above directive are conformed:

1.5.1, 1.5.11, 1.5.12, 1.6.1-1.6.3, 1.7.2, 1.7.3

we hereby declare that the following EHSRs have been complied with:

EN11553-1: Safety of Machinery – Laser Processing Machines
EN60204-1: Safety of Machinery – Electrical Equipment of Machines
EN60825-1: Safety of laser products – 1 Equipment Classification and Requirements
EN60825-4: Safety of Laser Products – Laser Guards
IEC13849-1: Safety of machinery – Safety Related Parts of Control Systems

and the technical documentation is compiled in accordance with Annex VII (B of the Directive).

We undertake to transmit, in response to a reasoned request by the appropriate national authorities, relevant information on the partly completed machinery identified above. The method of transmission shall be at the discretion of Miyachi Unitek Corporation.

The machinery is incomplete and must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the Directive.

Signed by: _____

Name: Matthew Green
Position: Project Manager, Standard Product R&D
Done at: 1820 S. Myrtle Ave
Monrovia, CA 91016
On: 05/2014

The technical documentation for the machinery is available from:

Name: Dieter Kemmerer-Fleckenstein
Miyachi Europe GmbH
Lindberghstrasse 1; D-82178 Puchheim; Deutschland / Germany

LIMITED WARRANTY

1. (a) Subject to the exceptions and upon the conditions set forth herein, Seller warrants to Buyer that for a period of one (1) year from the date of shipment ("**Warranty Period**"), that such Goods will be free from material defects in material and workmanship.

(b) Notwithstanding the foregoing and anything herein to the contrary, the warranty set forth in this Section 1 shall be superseded and replaced in its entirety with the warranty set forth on **Exhibit A** hereto if the Goods being purchased are specialty products, which include, without limitation, laser products, fiber markers, custom systems, workstations, Seller-installed products, non-catalogue products and other custom-made items (each a "**Specialty Products."**

(c) EXCEPT FOR THE WARRANTY SET FORTH IN SECTION 1(A), SELLER MAKES NO WARRANTY WHATSOEVER WITH RESPECT TO THE GOODS (INCLUDING ANY SOFTWARE) OR SERVICES, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.

(d) Products manufactured by a third party and third party software ("**Third Party Product**") may constitute, contain, be contained in, incorporated into, attached to or packaged together with, the Goods. Third Party Products are not covered by the warranty in Section 1(a). For the avoidance of doubt, **SELLER MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO ANY THIRD PARTY PRODUCT, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.** Notwithstanding the foregoing, in the event of the failure of any Third Party Product, Seller will assist (within reason) Buyer (at Buyer's sole expense) in obtaining, from the respective third party, any (if any) adjustment that is available under such third party's warranty.

(e) Seller shall not be liable for a breach of the warranty set forth in Section 1(a) unless: (i) Buyer gives written notice of the defect, reasonably described, to Seller within five (5) days of the time when Buyer discovers or ought to have discovered the defect and such notice is received by Seller during the Warranty Period; (ii) Seller is given a reasonable opportunity after receiving the notice to examine such Goods; (iii) Buyer (if requested to do so by Seller) returns such Goods (prepaid and insured to Seller at 1820 South Myrtle Avenue, Monrovia, CA 91016or to such other location as designated in writing by Seller) to Seller pursuant to Seller's RMA procedures and Buyer obtains a RMA number from Seller prior to returning such Goods for the examination to take place; and (iii) Seller reasonably verifies Buyer's claim that the Goods are defective and that the defect developed under normal and proper use.

(f) Seller shall not be liable for a breach of the warranty set forth in Section 1(a) if: (i) Buyer makes any further use of such Goods after giving such notice; (ii) the defect arises because Buyer failed to follow Seller's oral or written instructions as to the storage, installation, commissioning, use or maintenance of the Goods; (iii) Buyer alters or repairs such Goods without the prior written consent of Seller; or (iv) repairs or modifications are made by persons other than Seller's own service personnel, or an authorized representative's personnel, unless such repairs are made with the written consent of Seller in accordance with procedures outlined by Seller.

(g) All expendables such as electrodes are warranted only for defect in material and workmanship which are apparent upon receipt by Buyer. The foregoing warranty is negated after the initial use.

(h) Subject to Section 1(e) and Section 1(f) above, with respect to any such Goods during the Warranty Period, Seller shall, in its sole discretion, either: (i) repair or replace such Goods (or the defective part) or (ii) credit or refund the price of such Goods at the pro rata contract rate, provided that, if Seller so requests, Buyer shall, at Buyer's expense, return such Goods to Seller.

(i) THE REMEDIES SET FORTH IN SECTION 1(H) SHALL BE BUYER'S SOLE AND EXCLUSIVE REMEDY AND SELLER'S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN SECTION 1(A). Representations and warranties made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty, as set forth above, shall not be binding upon Seller.

Exhibit A
Warranty for "Specialty Products"

Limited Warranty

EXCEPT FOR THE WARRANTY SET FORTH BELOW IN THIS EXHIBIT A, SELLER MAKES NO WARRANTY WHATSOEVER WITH RESPECT TO THE GOODS (INCLUDING ANY SOFTWARE) OR SERVICES, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.

Warranty Period: The Warranty Period for Specialty Products is for one (1) year, and the Warranty Period for laser welders and laser markers is two (2) years (unlimited hours), and the Warranty Period for the laser pump diodes or modules is two (2) years or 10,000 clock hours, whichever occurs first (as applicable, the "**Warranty Period**"). The Warranty Period begins as follows: (i) on orders for Goods purchased directly by Buyer, upon installation at Buyer's site or thirty (30) days after the date of shipment, whichever occurs first; or (ii) on equipment purchased by a Buyer that is an OEM or systems integrators, upon installation at the end user's site or six (6) months after the date of shipment, whichever occurs first.

Acceptance Tests: Acceptance Tests (when required) shall be conducted at Amada Miyachi America, Inc., Monrovia, CA, USA (the "**Testing Site**") unless otherwise mutually agreed in writing prior to issuance or acceptance of the Acknowledgement. Acceptance Tests shall consist of a final visual inspection and a functional test of all laser, workstation, enclosure, motion and accessory hardware. Acceptance Tests shall include electrical, mechanical, optical, beam delivery, and software items deliverable under the terms of the Acknowledgement. Terms and conditions for Additional Acceptance Tests either at Seller's or Buyer's facility shall be mutually agreed in writing prior to issuance or acceptance of the Acknowledgement.

Performance Warranty: The system is warranted to pass the identical performance criteria at Buyer's site as demonstrated during final Acceptance Testing at the Testing Site during the Warranty Period, as provided in the Acknowledgement. Seller explicitly disclaims any responsibility for the process results of the laser processing (welding, marking, drilling, cutting, etc.) operations.

Exclusions: Seller makes no warranty, express or implied, with respect to the design or operation of any system in which any Seller's product sold hereunder is a component.

Limitations: The limited warranty set forth on this Exhibit A does not cover loss, damage, or defects resulting from transportation to Buyer's facility, improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the equipment, or improper site preparation and maintenance. This warranty also does not cover damage from misuse, accident, fire or other casualties of failures caused by modifications to any part of the equipment or unauthorized entry to those portions of the laser which are stated. Furthermore, Seller shall not be liable for a breach of the warranty set forth in this Exhibit A if: (i) Buyer makes any further use of such Goods after giving such notice; (ii) the defect arises because Buyer failed to follow Seller's oral or written instructions as to the storage, installation, commissioning, use or maintenance of the Goods; (iii) Buyer alters or repairs such Goods without the prior written consent of Seller; or (iv) repairs or modifications are made by persons other than Seller's own service personnel, or an authorized representative's personnel, unless such repairs are made with the written consent of Seller in accordance with procedures outlined by Seller.

Seller further warrants that all Services performed by Seller's employees will be performed in a good and workmanlike manner. Seller's sole liability under the foregoing warranty is limited to the obligation to re-perform, at Seller's cost, any such Services not so performed, within a reasonable amount of time following receipt of written notice from Buyer of such breach, provided that Buyer must inform Seller of any such breach within ten (10) days of the date of performance of such Services.

Seller shall not be liable for a breach of the warranty set forth in this Exhibit A unless: (i) Buyer gives written notice of the defect or non-compliance covered by the warranty, reasonably described, to Seller within five (5) days of the time when Buyer discovers or ought to have discovered the defect or non-compliance and such notice is received by Seller during the Warranty Period; (ii) Seller is given a reasonable opportunity after receiving the notice to examine such Goods and (a) Buyer returns such Goods to Seller's place of business at Buyer's cost (prepaid and insured); or (b) in the case of custom systems, Seller dispatches a field service provider to Buyer's location at Buyer's expense, for the examination to take place there; and (iii) Seller reasonably verifies Buyer's claim that the Goods are defective or non-compliant and the defect or non-compliance developed under normal and proper use.

All consumable, optical fibers, and expendables such as electrodes are warranted only for defect in material and workmanship which are apparent upon receipt by Buyer. The foregoing warranty is negated after the initial use.

No warranty made hereunder shall extend to any product whose serial number is altered, defaced, or removed.

Remedies: With respect to any such Goods during the Warranty Period, Seller shall, in its sole discretion, either: repair such Goods (or the defective part). **THE REMEDIES SET FORTH IN THE FOREGOING SENTENCE SHALL BE BUYER'S SOLE AND EXCLUSIVE REMEDY AND SELLER'S ENTIRE LIABILITY FOR ANY BREACH OF THE LIMITED WARRANTY SET FORTH IN THIS EXHIBIT A.** Representations and warranties made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty, as set forth above, shall not be binding upon Seller.

Products manufactured by a third party and third party software ("**Third Party Product**") may constitute, contain, be contained in, incorporated into, attached to or packaged together with, the Goods. Third Party Products are not covered by the warranty in this Exhibit A. For the avoidance of doubt, **SELLER MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO ANY THIRD PARTY PRODUCT, INCLUDING ANY (a) WARRANTY OF MERCHANTABILITY; (b) WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE; (c) WARRANTY OF TITLE; OR (d) WARRANTY AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF A THIRD PARTY; WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE.** Notwithstanding the foregoing, in the event of the failure of any Third Party Product, Seller will assist (within reason) Buyer (at Buyer's sole expense) in obtaining, from the respective third party, any (if any) adjustment that is available under such third party's warranty.

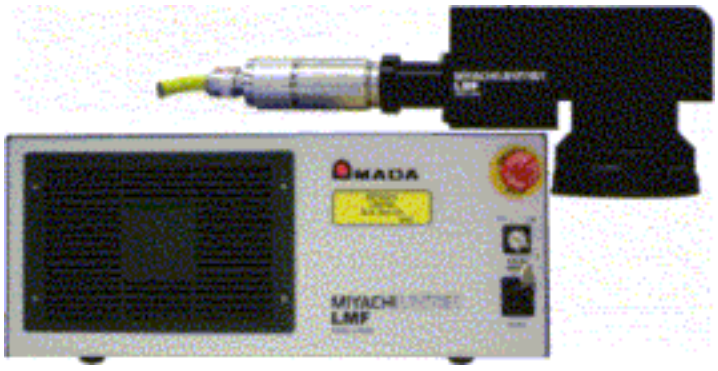
CHAPTER 1
SYSTEM DESCRIPTION

Section I: Features

The LMF Series Fiber Laser Markers are high-precision scanning fiber laser markers, either pulsed or Q-switched depending on the configuration as delivered. For the rest of this manual, all models of the LMF Series Fiber Laser Markers will simply be referred to as "***the Marker,***" except in specific instances where unique descriptions are required such as specifications, connections, etc.

This Marker is configured to operate with *WinLase* laser control software. Please refer to the software manual for details.

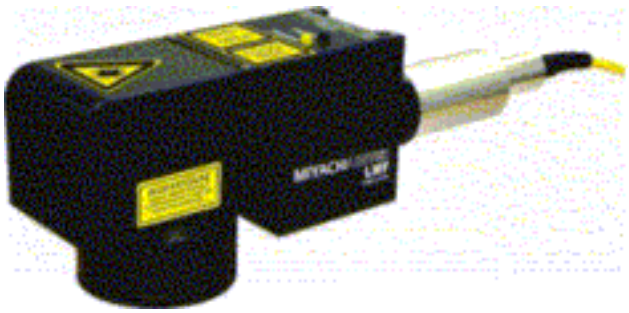
Laser Marking



- **Permanent marking.**
  In contrast to ink-based printing, laser marking is permanent, since the laser beam changes the material itself.
- **Environmentally friendly.**
  No ink is needed, so no solvent is used.
  Use of recycling marked materials is easier because they contain no ink.
- **Non-contact marking.**
  Permits marking of curved and concave surfaces.

Features

- **Compact and lightweight.**
  Ideal for production lines where space is limited.
- **Energy efficient.**
  Low power consumption, thanks to a highly efficient laser diode.
- **Compact IP-54 head standard.**
- **Fully air-cooled.**
  Easy maintenance. No coolant or coolant filters needed.



2D Miniscan Ultra Compact
High Performance Scanner

AF (Adjustable Focus)
High Performance Scanner

- **Compatible with PCs running with the *Windows*™ operating system.**

  The WinLase application runs in *WindowsXP*™ Service Pack 3 or newer and *Windows 7 Professional*™ *32-bit* with all Microsoft Updates applied. The software is user-friendly and fully-featured which allows you to easily program the most complicated marking operations. When using *WinLase*, one PC can simultaneously administer multiple markers.

- **High-speed marking.**

  Capable of marking at extremely high speeds (≥ 5000mm/s) for the fastest possible marking time. The maximum speed for each process is dependent on the selected optical configuration and the material being marked.

- **Built-in guide beam.**

  A visible red guide beam for positioning makes it easy to align marking positions.

- **Full-featured drawing functions allow for more efficient production of marking data.**

  Functions include: move, rotate, copy, enlarge, reduce, compress, mirror text, reverse marking, undo, redo, grid, ruler.

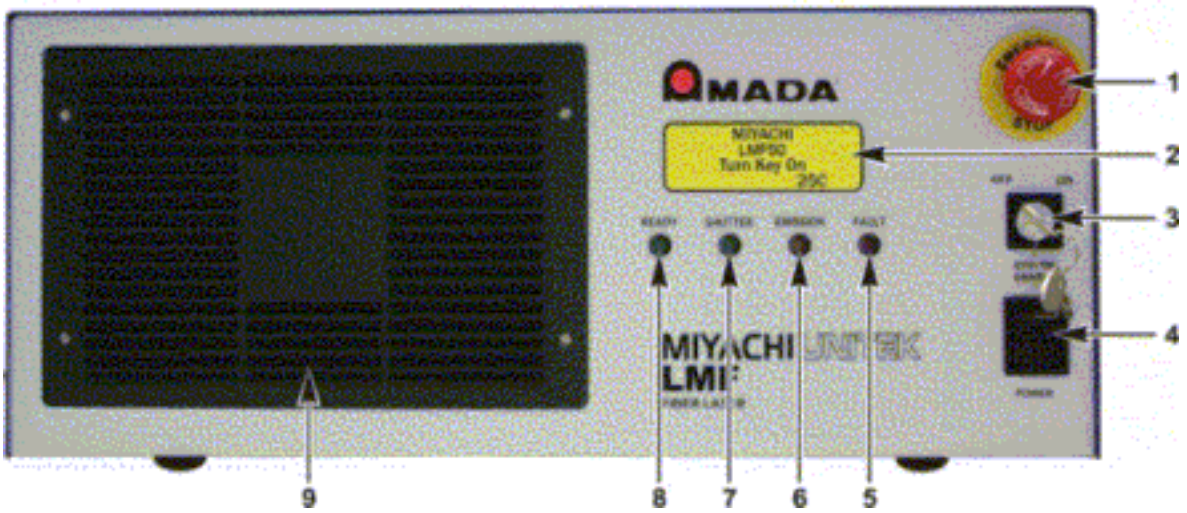
- **Stand-alone capabilities.**

  Depending on the hardware configuration of the Marker, it can be run independently of a PC. When configured with the WinLase marking software, the marker can store marking jobs on the built-in 10MB flash memory (expandable) and then the jobs can be run via the External I/O, RS-232, or TCP/IP.

Section II: Part Names and Functions

Control Unit (Front)

The control unit incorporates the controller, electronic cooling unit, interface hardware, and power supply unit. You can monitor the operating status from a computer using the TCP/IP protocol.



CAUTION

Use the **Emergency Stop Button** to stop the device ***only*** in emergency situations. Use the key switch and main power switch for normal use.

1 Emergency Stop Button

Press to stop all marking processes immediately during an emergency. This will immediately suspend marking, close the shutter, provide a fault signal to the operator, cease motion, and shut down the laser diode power supply. Once pressed, the button will remain depressed. To reset this button, turn the knob in the direction indicated by the arrows. To reset the laser, either cycle the key switch or send an I/O signal to "Fault Reset" as described in *Appendix B, Electrical and Data Connections*.

2 LCD Display Window.

Describes various messages on the status of the Marker and any system faults or errors that may occur during marking.

3 SYSTEM ENABLE Key Switch

Enables marking. This key switch must be in the ON position to open the safety shutter and enable marking. If the key switch is in the OFF position the marker is incapable of laser emission. The marker can still be operated using the guide beam only with the key switch in the off position.

4 POWER Switch

This switch allows the Operator to turn the Marker ON and OFF. The INPUT POWER switch on the rear panel must be turned ON in order for this switch to become active.

5 FAULT Light

Indicates that an error has occurred. The specific fault is indicated by a coded series of flashes. Please note the sequence and refer to this manual for resolution. Identical information is available on the LCD display.

6 EMISSION Light

Indicates that marking is underway. This indicator will be briefly illuminated during initial power up as a self-check mechanism, but emission does not occur.

7 SHUTTER Light

Indicates that the Safety Shutter in the laser head is open.

8 READY Light

Indicates that the Marker is ready to mark.

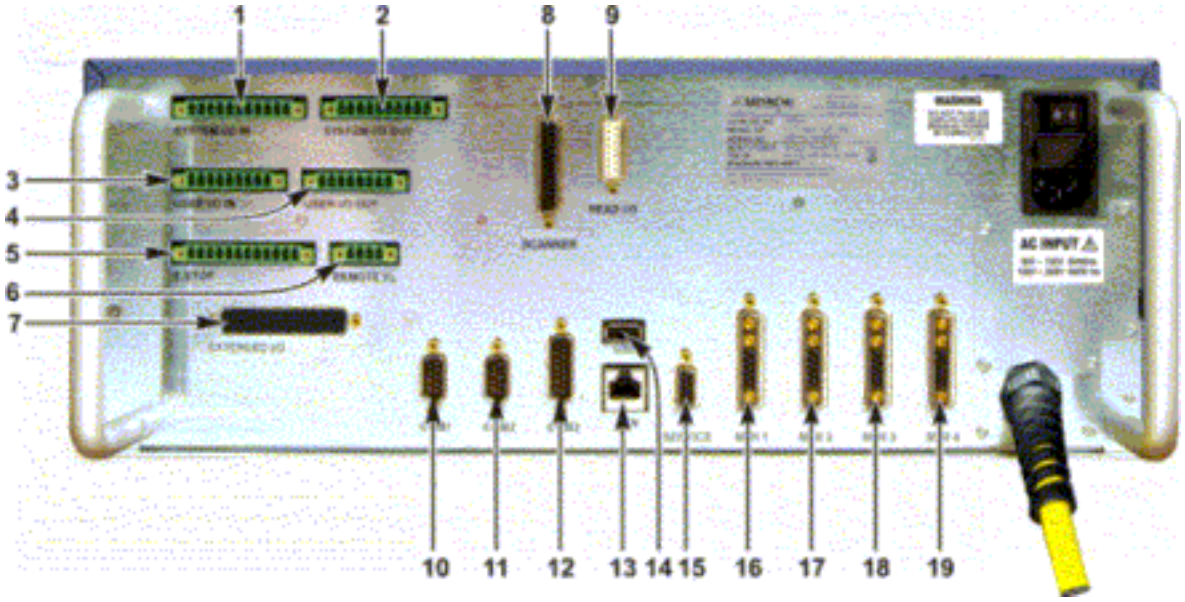
NOTES:

- The **READY** indicator is illuminated when no faults are detected and the laser power supply is booted and ready.
- The **READY** indicator may be delayed by network settings preventing fast assignment of an IP address to the laser marker.
- The Marker may be powered OFF at any time.

9 Cooling Fan Air Intake

Clean the air filter at regular intervals. See *Chapter 4, Maintenance* for more details.

Control Unit (Rear)



1 SYSTEM I/O IN Connector

This connector allows for control of marker functions using external control. Features that can be controlled include Mark Start, the Safety Shutter, Laser Enable, Fault Reset, etc. Please see *Appendix B, Electrical and Data Connections* for details.

2 SYSTEM I/O OUT Connector

This connector allows the user to interface with status outputs using external control. Signals that can be monitored include Fault conditions, Emission, System Ready, Mark in Progress, etc. See *Appendix B, Electrical and Data Connections* for details.

3 USER I/O IN Connector

This connector contains programmable inputs to the Marker. The behavior exhibited when these signals are sent is programmed by the operator using the WinLase software package.

4 USER I/O OUT Connector

This connector contains programmable outputs controlled by the WinLase software package.

5 E-STOP (Emergency Stop) Connector

This connector allows the user to integrate an external Emergency Stop button to the marker, integrate the system into a larger machine emergency stop control system, and provides outputs on the state of the Emergency Stop circuit. Please refer to *Appendix B, Electrical and Data Connections* for details.

6 REMOTE I/L (Interlock) Connector

This two channel dry contact connection is used to control the laser's remote interlock. If the remote interlock is activated the safety shutter is immediately closed and laser emission is discontinued. An error message is sent to the front panel if a marking operation is in progress. The software monitors the interlock for error handling and synchronization purposes.

7 EXTENDED I/O Connector

This connector allows the user to address 8-bit I/O job selection as well as additional I/O. Please refer to *Appendix B, Electrical and Data Connections* for details on how to wire this connector.

8 SCANNER Connector

This 25-pin D-Sub cable contains power and digital communication signals for the laser scan head. Please do not operate the marker without this connected as it may damage the scanhead or cause un-aimed laser emission. Do ***not*** plug or unplug this connector when power is ON.

9 LASER HEAD I/O Connector

This 15-pin D-Sub cable contains communication signals between the marker and laser head including head interlocks, shutter power and sensor signals, etc. If this cable is disconnected the marker will be in the Emergency Stop state.

10 COM1 Connector

This connector is primarily used for RS-232 connection to the WinLase Remote API. It allows the user to communicate via a simplified 3-wire RS-232 implementation using pins 2, 3, and 5 for Received Data, Transmitted Data, and Ground respectively when Hardware Flow Control is disabled.

11 COM2 Connector

This connector allows the user to communicate via a simplified 3-wire RS-232 implementation using pins 2, 3, and 5 for Received Data, Transmitted Data, and Ground respectively when Hardware Flow Control is disabled. Pin 9 is connected to +5V to provide pendant power, so ensure that any other devices that connect to this port cannot be damaged.

12 COM3 Connector

This connector allows the user to connect serial stepper motors or an encoder to be used with **Mark on the Fly**. Motor connections to this port are for legacy motion applications requiring a separate motion power supply. When possible use MTR 1-4 connectors instead as power and control are available on these ports and no separate motion power supply is required. Please see *Appendix B, Electrical & Data Connections* for more details.

13 ETHERNET LAN Connector

Use this port to connect the marker to a Category 5e cable if using the WinLase software package. Select your Category 5e cable depending on the network configuration you plan to use. If the marker is to be directly connected to a PC use a Cat 5e crossover type cable. If the marker is to be connected to a Local Area Network via a hub or switch, use a standard Cat 5e patch cable.

14 USB Connector

This port is used to add additional job and graphic storage to the unit. Use a USB flash drive only. Not all flash drives are supported. One recommended brand/model is the *PNY Optima Attache*.

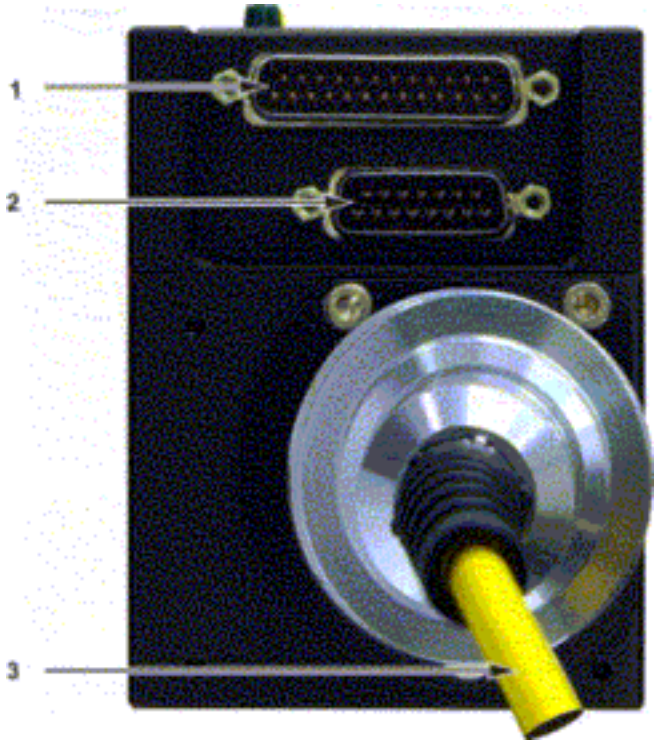
15 SERVICE Connector

Reserved for factory diagnostic and configuration use.

16-19 MTR 1-4 Connector

These connectors are used to connect individual serial stepper motors for motion control. Power and communication are provided on each individual connector. When using these connectors it is not necessary to use the motor signals on COM3.

2D Laser Head (Rear)



1. Laser Scanner Connector

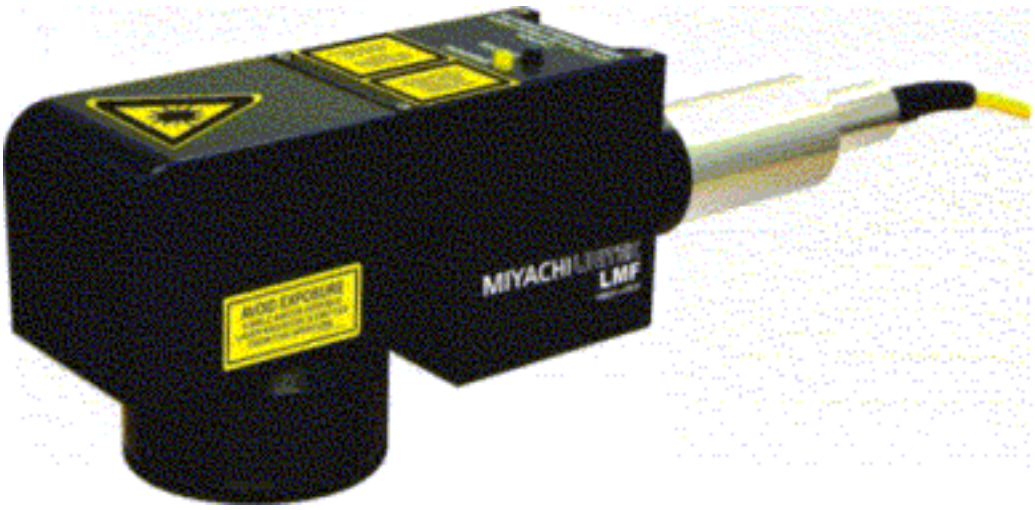
This 25-pin D-Sub cable contains power and digital communication signals for the laser scan head. Do not operate the marker without this connected as it may damage the scanhead. ***Do not plug or unplug this connector when power is ON*** since hardware damage *will* occur.

2. Laser Head Control Connector

This 15-pin D-Sub cable contains the communication signals between the marker and laser head including head interlocks, shutter control and sensor signals, etc. If this cable is disconnected the marker will be in the Emergency Stop state.

3. Optical Fiber

Optical fiber that connects the Laser output to the Laser head. NEVER allow the fiber bend radius to decrease to less than 4.7" (120mm). ***NEVER*** kink, crush, or twist the fiber. Fiber damage will require refurbishment of the laser power supply. The fiber is shipped installed and aligned and does not require adjustment. To prevent optical fiber damage, do not remove the fiber.



2D Ultra Compact Laser Head (All Models)

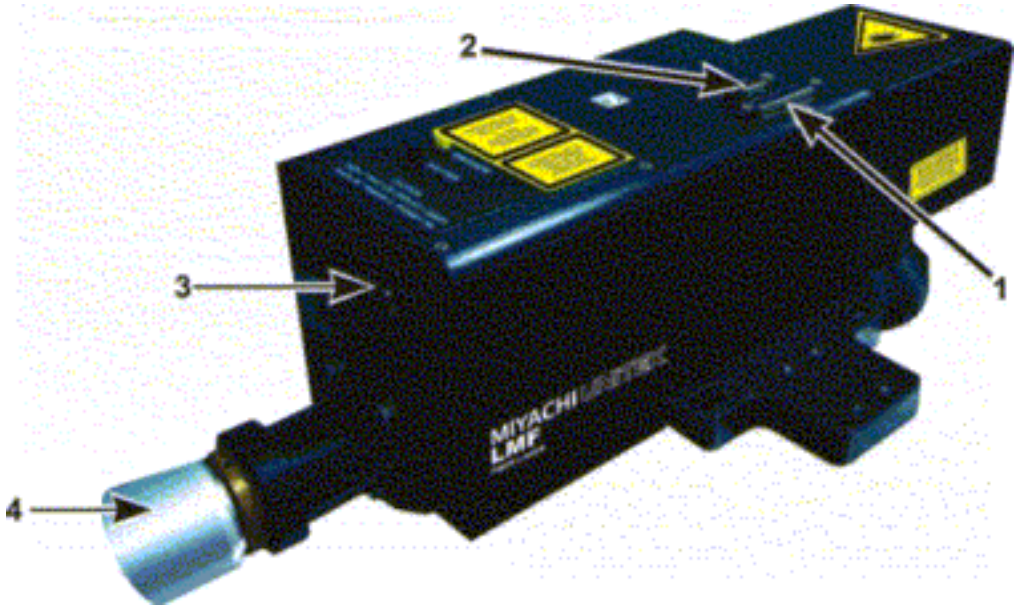
The ultra-compact laser head is equipped with a high performance Miniscan scanner and is packaged in an extremely small sealed enclosure. Using mass-reduced mirrors and high performance galvanometers with precise, matched drivers gives this scanner improved speed, thermal drift, temporal drift, and better overall repeatability. The extremely compact size makes it easier to fit into tight spaces. By special order, some Laser models can operate in ambient temperatures as high as 40° Celsius (Laser Head only).

Some models include changeable beam diameter optics with "safety latch" features.

Specifications include:

> 5.0m/s marking speed, > 9.0m/s positioning speed
12µrad Resolution
20µrad Repeatability
0.005%/K Maximum Gain Drift per axis
30µrad/K Maximum Offset Drift per axis
< 300µrad Long Term Drift over 8 hours
IP-54+ environmental protection

AF (Adjustable Focus) Laser Head (Rear)



1. Laser Scanner Connector

This 25-pin D-Sub cable contains the digital communication signals for the laser scan head. Do not operate the marker without this connected as it may damage the scanhead. ***Do not plug or unplug this connector when power is ON*** since hardware damage *will* occur.

2. Laser Scanner Power Connector

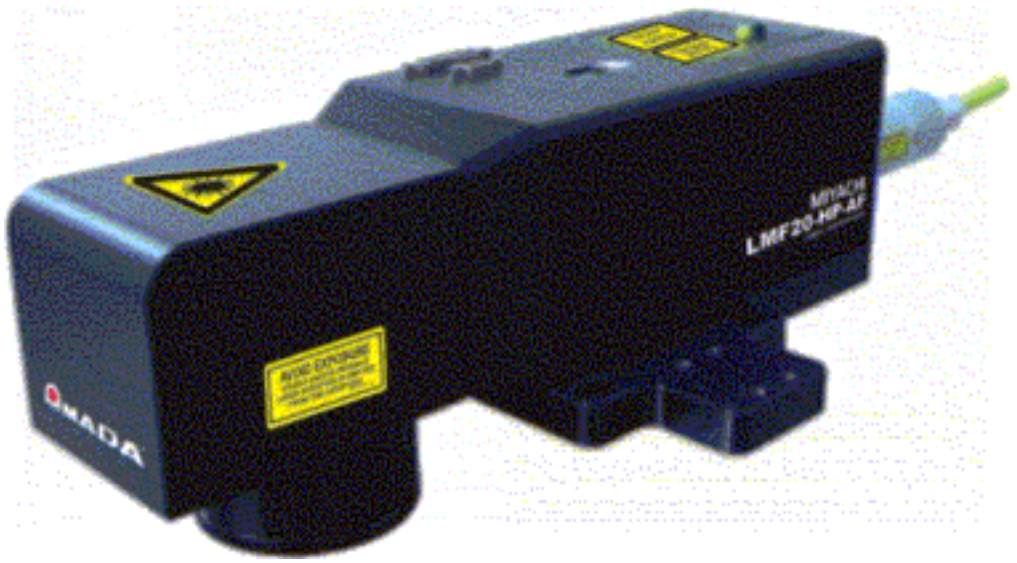
This 9-pin D-Sub cable contains the power signals for the laser scan head. Do not operate the marker without this connected as it may damage the scanhead. ***Do not plug or unplug this connector when power is ON*** since hardware damage *will* occur.

3. Laser Head I/O Control Connector

This 15-pin D-Sub cable contains the communication signals between the marker and laser head including head interlocks, shutter control and sensor signals, etc. If this cable is disconnected the marker will be in the Emergency Stop state.

4. Beam Expander / Optical Fiber

Optical fiber that connects the Laser output to the Laser head. NEVER allow the fiber bend radius to decrease to less than 4.7" (120mm). ***NEVER*** kink, crush, or twist the fiber. Fiber damage will require refurbishment of the laser power supply. The fiber is shipped installed and aligned and does not require adjustment. To prevent optical fiber damage, do not remove the fiber.



AF (Adjustable Focus) Laser Head

The AF (Adjustable Focus) laser head is equipped with a high performance Miniscan scanner and is packaged in an extremely small sealed enclosure. Using mass-reduced mirrors and high performance galvanometers with precise, matched drivers gives this scanner improved speed, thermal drift, temporal drift, and better overall repeatability. The extremely compact size makes it easier to fit into tight spaces. Some models can operate in ambient temperatures as high as 35° Celsius.

Specifications include:

20µrad Repeatability
50 ppm/K Maximum Gain Drift per axis
30µrad/K Maximum Offset Drift per axis
< 300µrad Long Term Drift over 8 hours
0.46ms Acceleration Time (10- 90%)
± 0.393 rad Typical Deflection

Options

The following items are available as options:

Component	Description
Protective Glass	The Marker is shipped with a protective glass affixed to the *f*-theta lens. If this glass becomes soiled or cracked a replacement may be purchased.
High Precision Serial Stepper Motors with cables	Up to 4 motors can be connected for stepper motor control with optional encoders.
Air Filter (Control Unit)	An air filter is installed in the Control Unit at the time of purchase. Additional filters are available. Amada Miyachi America Part Numbers 4-68423-01 and 4-68424-01. Air filters should be replaced as a set with the black filter to the outside of the unit.
Lithium System Battery	CR2032 (Backup battery for internal memory) – Amada Miyachi America Part Number 145-017
Cat 5e Crossover Cable	For communications with a computer. Amada Miyachi America Part Number 205-318
Spares Kit, Level I	Spares kit containing; Air Filter (set), back-up battery, Power Supply Fuse, Lens Cleaning solution + Tissue, Spare I/O connectors. Amada Miyachi America Part Number 8-707-04-01
Spares Kit, Level II	Spares Kit containing: All of the items from the 8-707-04-01 Level Kit + replacement PCB's, fan and power supplies. Amada Miyachi America Part Number 8-707-04-0x
Auto-Focus Mounting Kit	The AF (Auto-Focus) Mounting Kit includes all hardware necessary to mount an AF Sensor (available separately). Amada Miyachi America # 8-922-01. *Note:* The AF Mounting Kit is designed to bolt on to the (4-70005-01) Auto-Focus Bracket (see image on previous page). Used with AF Laser Heads only.
*f*100mm AF Sensor Kit	AF Sensor kit for the *f*100 mm *f*-theta lens. Kit includes the sensor + mounting hardware (see *Chapter 7* for more details). Kit is designed to be used with the AF mounting kit (listed above). Used with AF Laser Heads only.
f 160mm AF Sensor Kit	AF Sensor kit for the *f*160 mm *f*-theta lens. Kit includes the sensor + mounting hardware (see *Chapter 7* for more details). Kit is designed to be used with the AF mounting kit (listed above). Used with AF Laser Heads only.

Section III: Compliance

Please refer to the Declaration of Incorporation in this manual for the fiber laser marker for compliance details. This product is sold ready for its intended purpose as a product for incorporation.

The end user and integrator are responsible for integration of the laser according to the information in this manual. With correct installation of the fiber laser marker in an appropriate enclosure the fiber laser marker system will comply with IEC13849-1 category 4. The $\mathbf{PL_r}$ of this system is **"e"**. Incorrect installation can defeat safety features, cause hazards to personnel, and invalidate compliance or cause compliance to be to a lesser category.

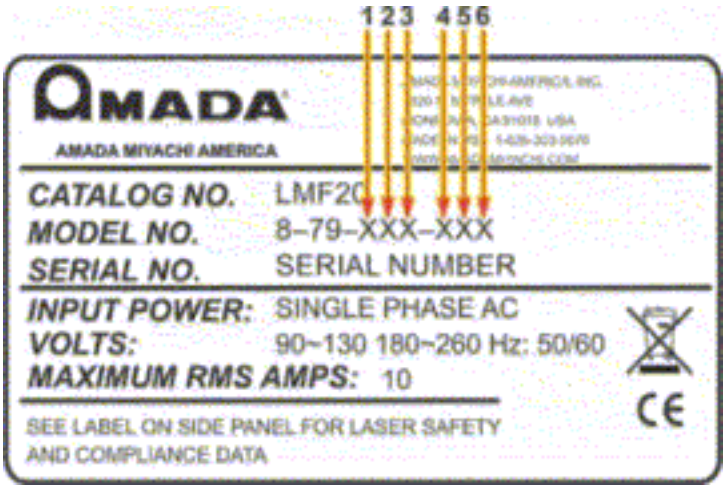
Compliance with IEC13849-1 achieved using the installation instructions in this manual affects only the fiber laser marker. Any additional equipment including the laser enclosure, automation controller, motion hardware, or other must be separately developed to be compliant with this specification or fiber laser marker compliance will be invalidated.

If compliance with IEC13849-1 is a concern the end user must validate their complete machine against the specification.

If there is any doubt about implementation, installation, or construction of the safety features of a machine at large including a fiber laser marker do not proceed without appropriate guidance.

Section IV: Identifying Model Number Components As Originally Shipped 8-79 Laser Models

See Specific Unit Label for Power Requirements



1	**Laser**	**B** = 50W HC (Q-switched 50-200kHz, $M^2 \leq 2.0$) Identifies LMF50 / ML-7350D with 3m Fiber **C** = 20W HC (Q-switched 20-200kHz, $M^2 \leq 2.0$) Identifies LMF20 / ML-7321D with 3m Fiber **D** = 10W HC (Q-switched 20-200kHz, $M^2 \leq 2.0$) Identifies LMF10 / ML-7311D with 5m Fiber **E** = 70W HC (Full Waveform Control, $M^2 < 1.6$) Identifies LMF70-HP / ML-7370D with 3m Fiber **P** = 20W SM (Full Waveform Control, Single Mode $M^2 \leq 1.3$) Identifies LMF20-SM / ML-7322D with 2m Fiber **Q** = 35W HM (Full Waveform Control, $M^2 \leq 3.5$) Identifies LMF35-HP / ML-7340D with 3m Fiber **R** = 20W HS, ST (Full Waveform Control, $M^2 \leq 2.0$) Identifies LMF20-HP / ML-7320D with 2m Fiber

2	**Control**	**L** = WinLase with LEC-1 Advanced License **B** = WinLase with LEC-1 Advanced License, Platform 6 **C** = WinLase with LEC-2 Advanced License **D** = WinLase with LEC-2 Standard License **E** = WinLase with LEC-2 Basic License

3	**Scan Head**	**A** = NONE **R** = 2D Miniscan High Performance Scanner **B** = AF (Adjustable Focus) Head

4	***f*** **Theta Lens** As shipped. Includes mounting collar.	**A** = NONE **B** = 100mm **C** = 160mm **E** = 254mm **F** = 420mm

5	**Beam Expanding / Collimator** B, C, D options not compatible with 8-79-**B** / 8-79-**C** / 8-79-**D** models.	**A** = NONE. LMF10, LMF 20, LMF 50 **B** = *f*30 Smallest beam size results in largest spot size at workpiece. Replaces old "1.5x" expander. **C** = *f*50 Medium beam size results in medium spot size at workpiece. Replaces old "4x" expander. Not compatible with the AF (Adjustable Focus) Head. **D** = *f*75 Largest beam size results in smallest spot size at workpiece. Replaces old "6x" expander. Not compatible with the AF (Adjustable Focus) Head.

6	**OEM Labeling**	**A** = Amada Miyachi America LMF Series **B** = Amada Miyachi ML-73xx Series

CHAPTER 2
INSTALLATION AND SETUP

Section I: Planning

When planning for the installation of the Marker, make sure that the following conditions are met:

- The Marker should be placed in a dedicated laser operation area and/or integrated into a suitable laser safe enclosure that meets all relevant safety standards. The person responsible for the area (the Laser Safety Officer) must isolate the laser operation area from other work areas and display signs warning that the laser operation area is off limits to unauthorized personnel.
- See *Appendix A: Technical Specifications* for specific weight and dimensional requirements as well as mounting hardware location and information.
- Use proper tools (wire strippers, pressure wire connectors, etc.) for termination of the connecting cables.
- The Marker should be placed on a firm, level surface that is free from vibration. Install the head and workpiece on the same fixture to prevent marking distortion due to vibration.
- Mount the head on a platform of sheet metal at least 0.394" (10 mm) thick.
- Do ***not*** operate the unit where there is considerable dirt, dust, oil mist, chemicals, fumes, moisture, or near a high-frequency noise source.
- The ambient temperature should be between 41°F and 95°F (5°C to 35°C). The installation area should be free of sudden temperature fluctuations and have a relative humidity less than 90% (non-condensing). The area should have no rapid temperature fluctuations, which may cause dew condensation on the optical surfaces.
- If the outside of the Marker is stained, wipe it with a dry or slightly moistened cloth. If it is badly stained, use a neutral detergent or alcohol to clean it. Do ***not*** use paint thinner, acetone, benzene, etc. which can discolor or deform the parts.
- The Control Unit and Laser Head must be located within the overall length of the optical fiber/cable set. See *Chapter 1, Section IV: Identifying Model Number* for more information on the shipped fiber length. The computer can be located anywhere as long as both the marker and PC have network accessibility and can be located on the same subnet.
- When installing two opposing laser heads, install them so that neither unit is aimed at the other.
- Install the Laser Head in any orientation desired.
- Make sure that the bend radius of the optical fiber on the back of the Laser Head is greater than 4.7" (120mm).

Allow adequate clearance on all sides of the Marker to allow for cooling, maintenance and servicing. Keep these following tips in mind during installation:

- When locating, ensure that the front air filter and side exhausts are clear for proper ventilation with at least 6 inches (15cm) of clearance.
- Both the Control Unit and the Laser Head should have a minimum of 6 inches (15 cm) behind the units for proper ventilation and cable clearance. The laser head is a sealed unit that requires no airflow clearance considerations be observed other than exposure to ambient air.
- The control unit must be placed on a hard surface to allow the bottom laser exhaust to function as designed.
- Do not block the bottom exhaust vent by placing the Control Unit on a soft surface like foam that can prevent adequate airflow.

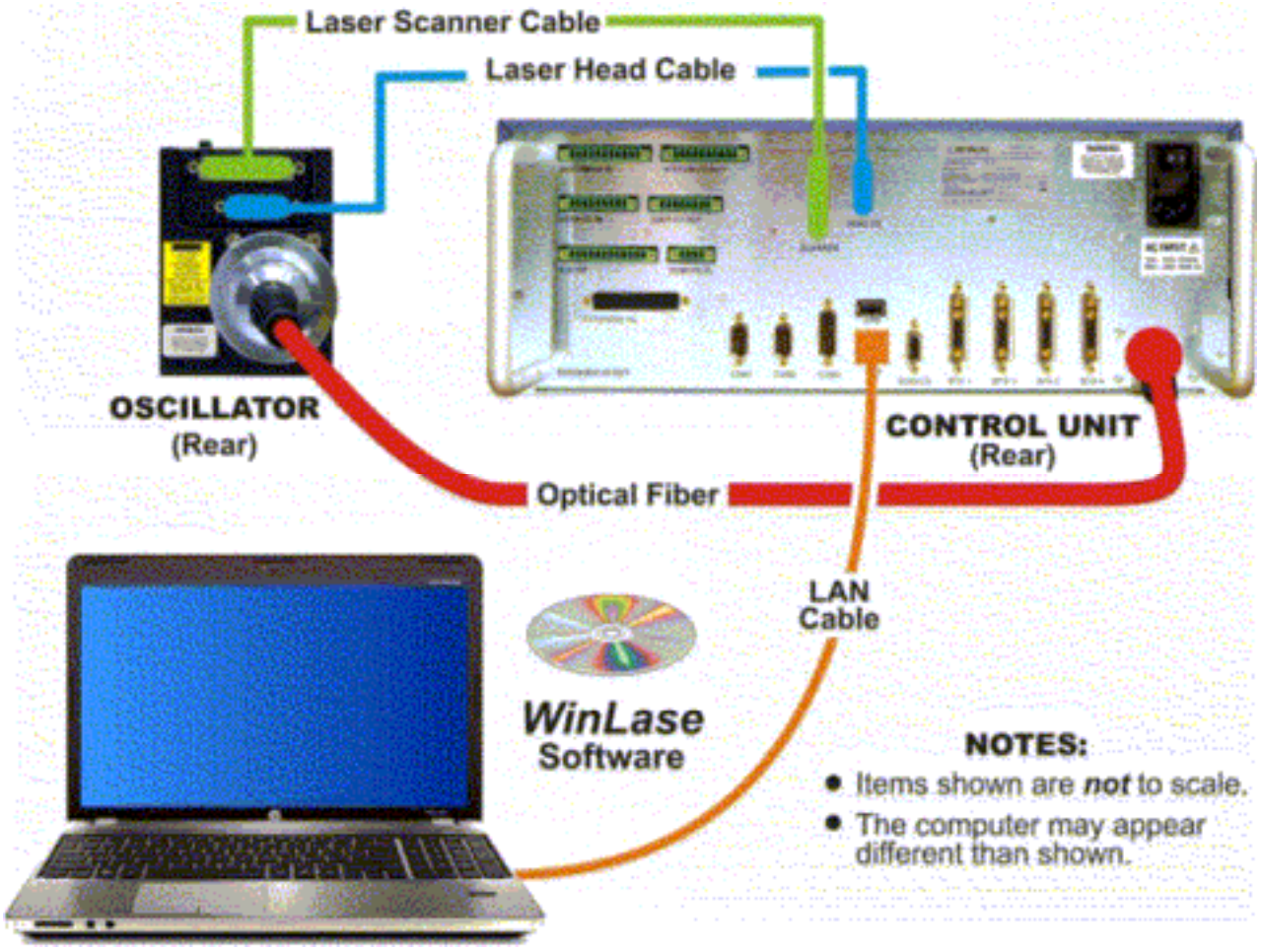
Section II: Installation

CAUTION

Do ***not*** attempt to remove the fiber at the rear of the marker head from the cylindrical isolator under any circumstances. Doing so will ***destroy*** the fiber and void the warranty. Amada Miyachi America assumes no liability for such action and the fiber will have to be replaced at the customer's expense.

Connect the Signal Cables

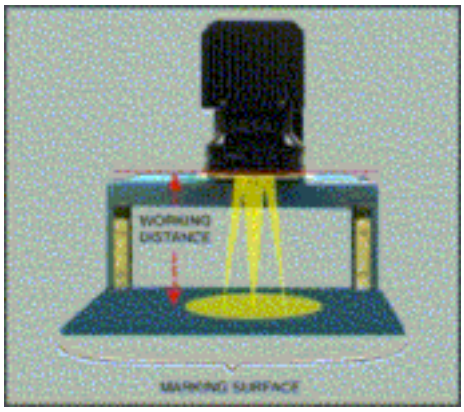
Connect the interconnect cables between the Marker Control Unit, Marker Head, and the Computer. Connect all cables as shown below. Secure all cables by fastening the connector backshells.



Set the Working Distance

In order to properly mark material, the working distance must be set in order to focus the laser beam onto the surface of the marking material. An incorrectly set working distance, will not produce an acceptable mark.

Set the distance as shown on the right. If the marking quality is unacceptable, then slightly adjust the marking material towards and away from the lens until the marking quality is acceptable. Measurements are given from the work surface to the lowest point of the lens ring on the lens assembly. Do ***not*** touch the cover glass while measuring the working distance.



Working Distance

***f*-theta lens**	**2D Miniscan Working Distance**	**AF(Adjustable Focus) Working Distance (z=0)**
f 100 mm	3.86 ± 0.04 in. (98 ± 1 mm)	3.84 ± 0.04 in. (97.5 ± 1 mm)
f 160 mm	6.93 ± 0.08 in. (176 ± 2mm)	6.81 ± 0.08 in. (172.9 ± 2mm)
f 254 mm	11.65 ± 0.12 in. (296 ± 3 mm)	11.65 ± 0.12 in. (295.9 ± 3 mm)
f 420 mm	19.45 ± 0.20 in. (494 ± 5 mm)	N/A

Verify the I/O Configuration is Correct

System I/O Inputs

If you plan to use customized External I/O, make sure that it is configured in accordance with *Appendix B, Electrical and Data connections*. If you will not be operating the Marker through the External I/O, verify that the factory-installed **System I/O In** jumper is configured as follows:

Jumper #1	Pin 2 connected to Pin 8 (Laser Enable)
Jumper #2	Pin 4 connected to Pin 8 (Shutter Open)
Jumper #3	Pin 9 connected to Pin 10 (Optocoupler Bias)

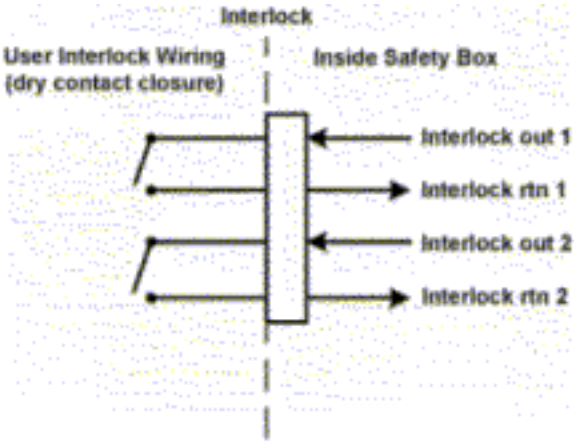
Section III: Integration with External Equipment

Proper integration of the fiber laser marker and external equipment is required for compliance with applicable safety regulations. The wiring diagrams in this section show typical implementations. Failure to select and implement a correct method of wiring can render the fiber laser marker unsafe.

Interlocks

The laser interlock mechanism is used to render the fiber laser marker safe for material handling without shutting down the laser itself. One example would be a door in a laser safety enclosure that must open for part loading and unloading. When the interlock channels are opened laser emission will cease and the laser safety shutter will close. If a laser mark operation is in process the fiber laser marker will be put into a fault condition that must be cleared before processing can start again. This interlock is designed to be connected to a laser enclosure safety door or any other device designed to protect personnel from laser radiation. A properly designed enclosure meeting the specifications of IEC60825-1 is a requirement, and the laser marker will comply with IEC60825-1 when correctly installed and wired in a compliant enclosure.

The laser interlock consists of two dry contact inputs. These must be opened and closed simultaneously or a fault will occur. There is no external reset required meaning that the interlock control circuit will allow laser operation as soon as the interlocks are closed. Rated life on the interlock circuit is 10 million cycles, after which the electromechanical components in the fiber laser marker must be replaced or renewed.

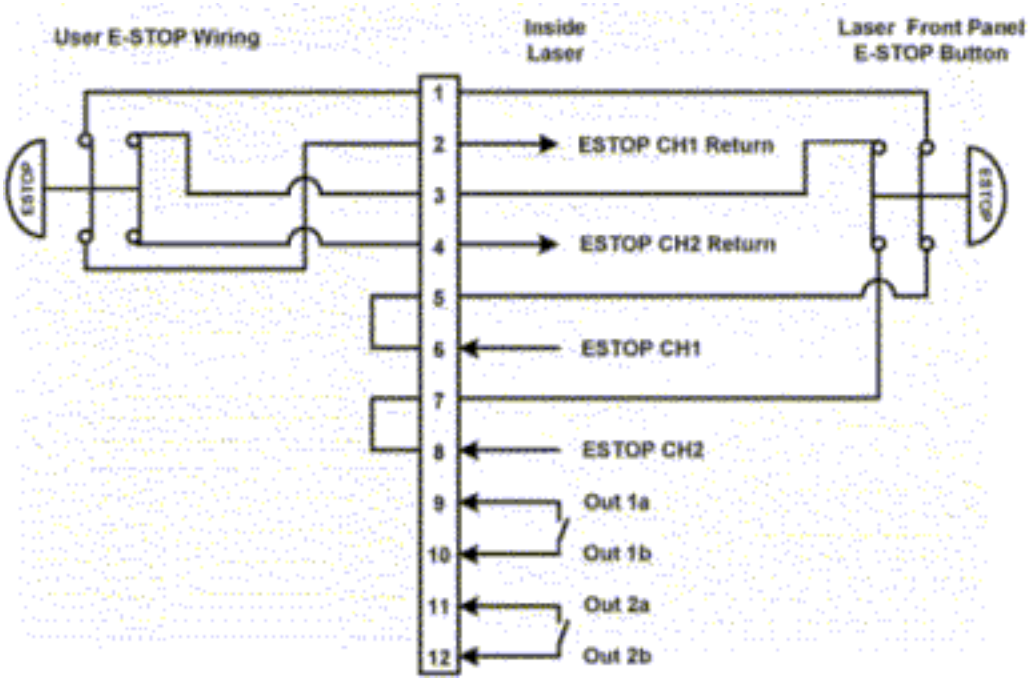


Emergency Stop for Simple Systems

Interfacing with External Emergency Stop Circuitry
E-STOP button(s) ONLY

The fiber laser marker can be interfaced to a simple system including an enclosure and one or more external emergency stop buttons. In this situation the fiber laser marker would not be connected to any larger automation system or control any other equipment. The dual channel output relays can be monitored to verify the status of the emergency stop circuit but no external equipment other than that outlined above should be included. Reset can be performed via the key switch or via the rear panel I/O reset input.

Dual channel relay outputs that close when the Safety Box AC power output is energized are available.



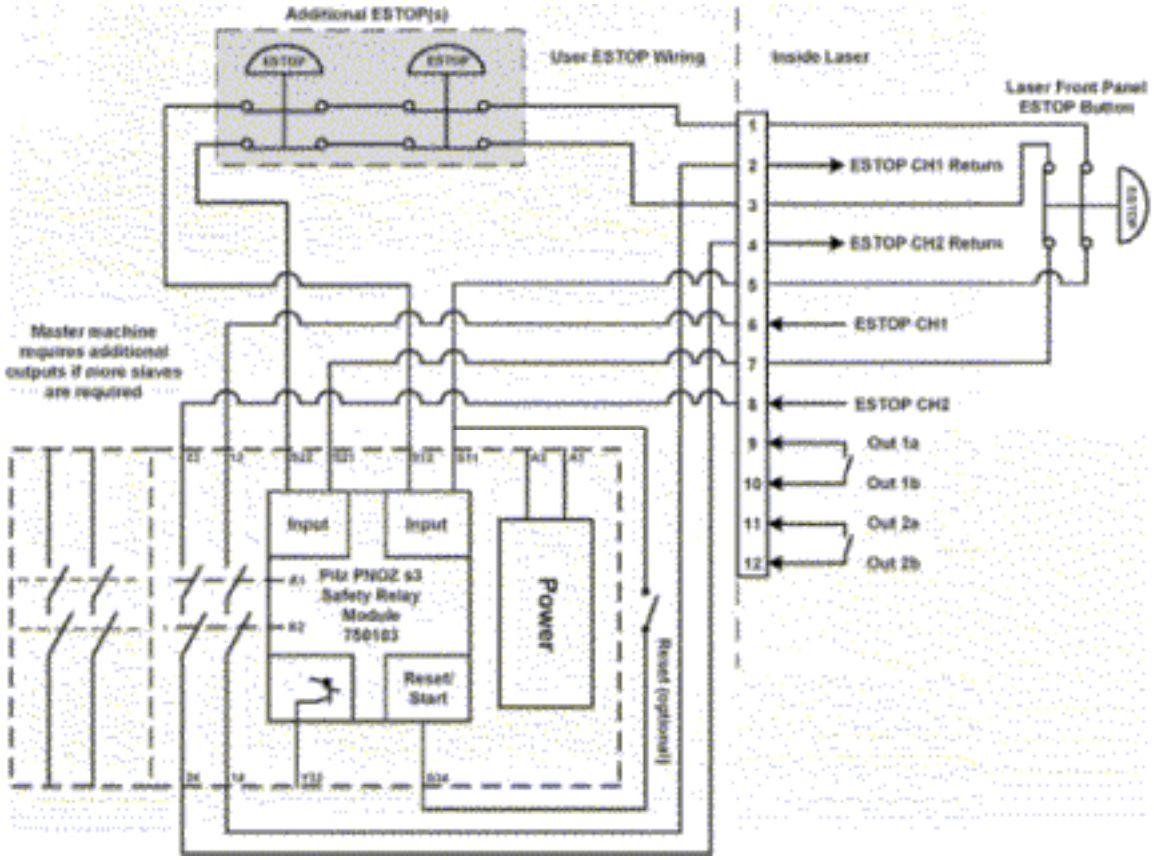
Emergency Stop for Complicated Systems

Interfacing with External Emergency Stop Circuitry
User Supplied Safety Relay Module(s) Required

Complicated Systems are those in which more than one emergency stop sub-circuit must be linked together. An example of this would be a machine that has a fiber laser marker, parts handler with pneumatic controls, PLC, and conveyor belt all of which have ESTOP buttons where one ESTOP button stops all devices. Any situation in which more than one device must be connected together and respond identically to an emergency stop event is considered a complicated system.

Complicated systems are integrated using certified safety controllers or safety relays. In this situation one device is the "master" and the rest of the devices are the "slaves". The fiber laser marker is considered a slave device in this configuration and its emergency stop must be controlled by the larger machine's safety controller. The output of the external safety relay module closes the input to the fiber laser marker safety box and allows the system to clear the emergency stop state.

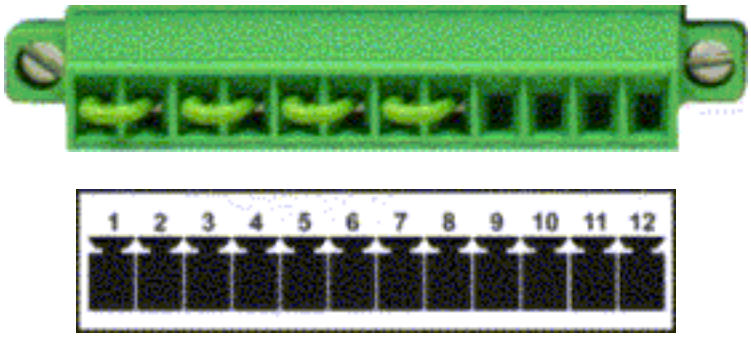
In this wiring example a Pilz PNOZ family safety relay module controls the fiber laser marker and interfaces two external emergency stop buttons. In this example the Pilz device would also control additional emergency stop functions outside of the fiber laser marker using expansion contacts. The more devices which must be implemented the more expansion contacts must be added to the Safety Relay Module. Any suitable IEC13849-1 compliant safety relay controller is acceptable as long as it is implemented in this manner. The end user is responsible for verifying compliance of the machine as a whole.



Emergency Stop Factory Test Jumper Wiring

Make sure that the **Emergency Stop** is wired in accordance with *Appendix B, Electrical and Data connections* and the safety requirements listed above. The factory-installed jumper must be removed and rewired according to all applicable safety standards for the system to meet specified levels of machine safety. Do not operate the machine without correctly integrating it into a workstation with the appropriate level of safety.

The factory-installed jumper for testing only is configured as follows:



Jumper #1	Pin 1 connected to Pin 2
Jumper #2	Pin 3 connected to Pin 4
Jumper #3	Pin 5 connected to Pin 6
Jumper #4	Pin 7 connected to Pin 8

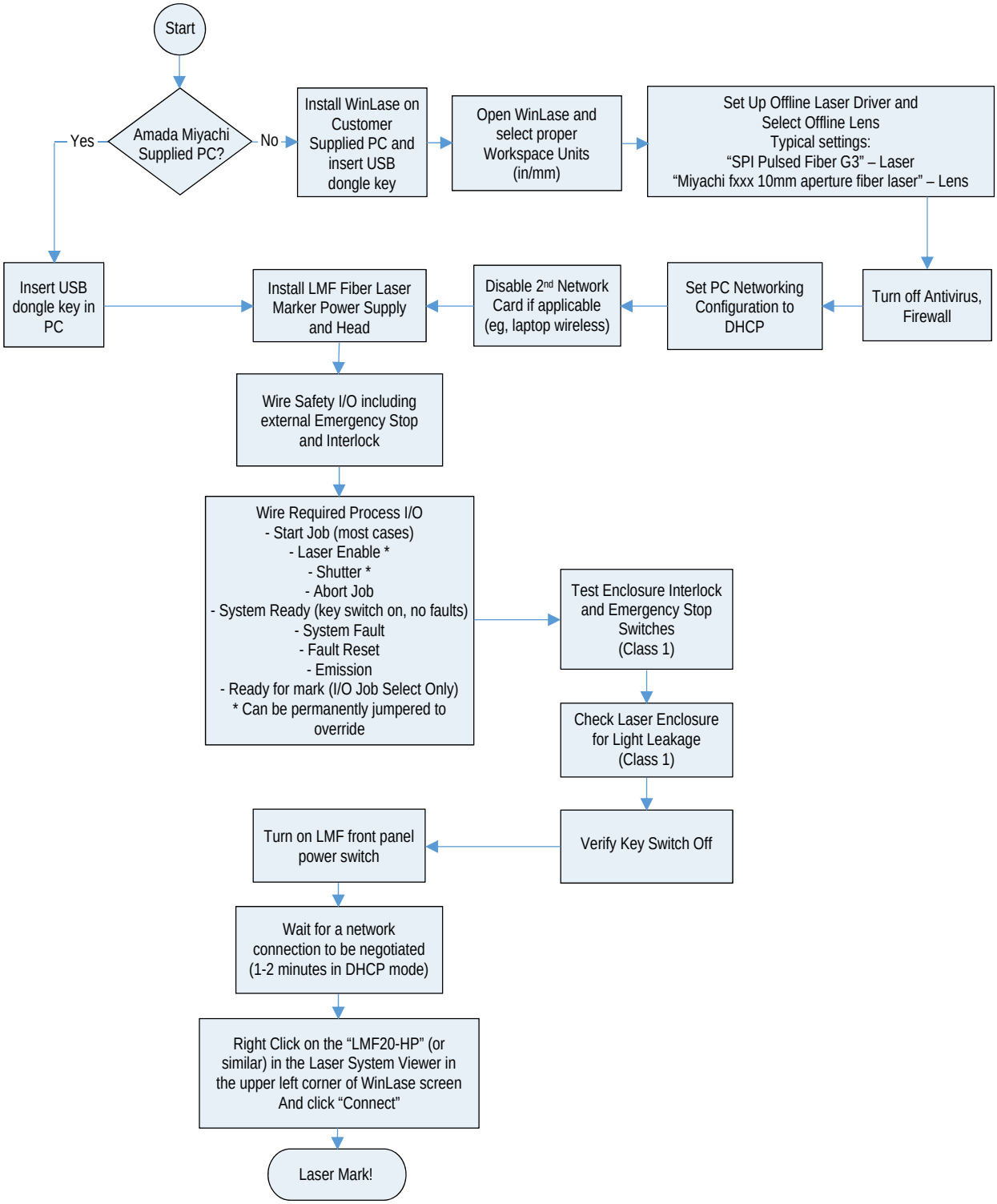
Remote Interlock Factory Test Jumper

Make sure the Remote Interlock is wired in accordance with *Appendix B, Electrical and Data connections*. The factory test jumper must be removed and wired according to all applicable safety standards for the system to meet specified levels of machine safety. Observe all laser precautions when testing with the factory test jumper installed. The factory-installed jumper for testing is configured as follows:

Jumper #1	Pin 1 connected to Pin 2
Jumper #2	Pin 3 connected to Pin 4

Section IV: Software Installation and Set-up

Installation Process Flow

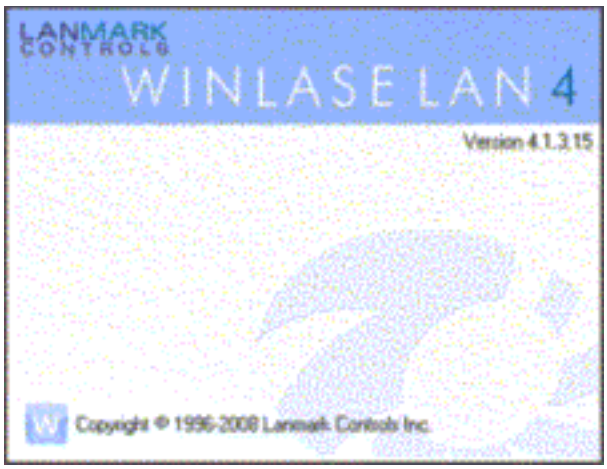


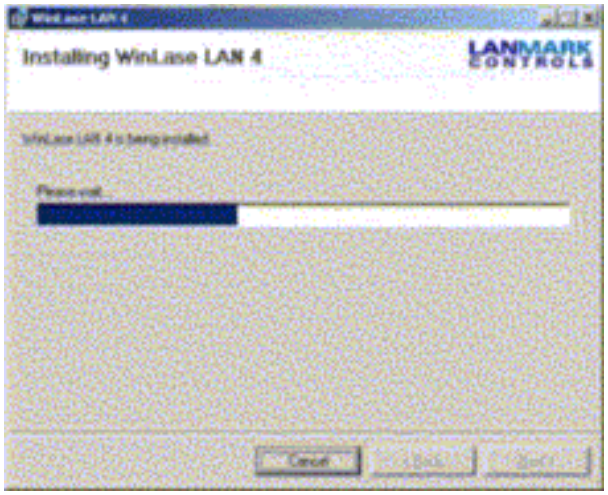
When Using a Factory-Supplied Computer

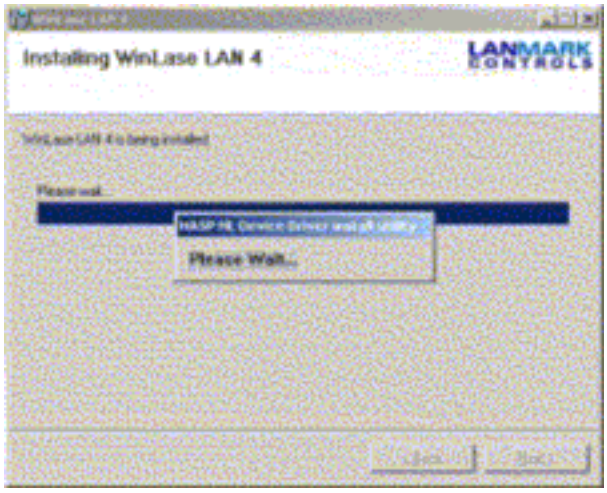
WinLase Marker Software is factory-installed making the Marker ready-to-use. No further installation is required. Please ensure the USB hardware key (dongle) is present for operation. Go to *Chapter 3* for operating instructions.

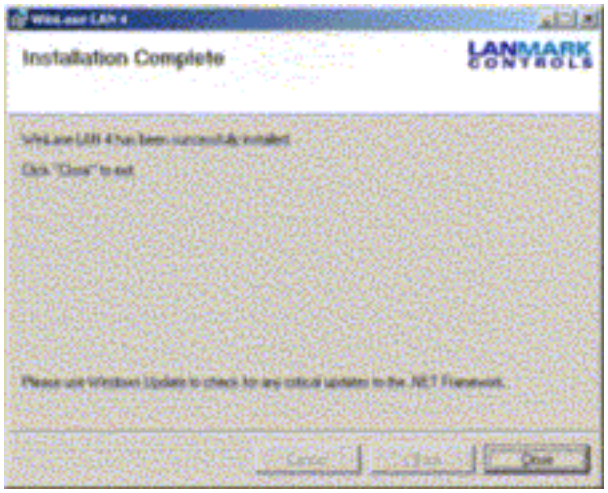
When Supplying your own Computer

1. Insert the *WinLase* CD ROM into your computer and follow the installation procedures. *Note:* The screen captured images shown in this section are from WinLase 4. Depending on the version of WinLase, the screen images may appear slightly different. However, the installation procedure is the same for all versions of WinLase. Use all recommended options for installation.

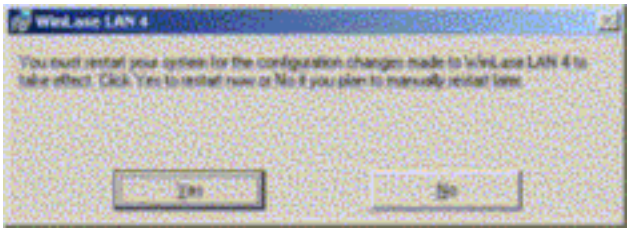




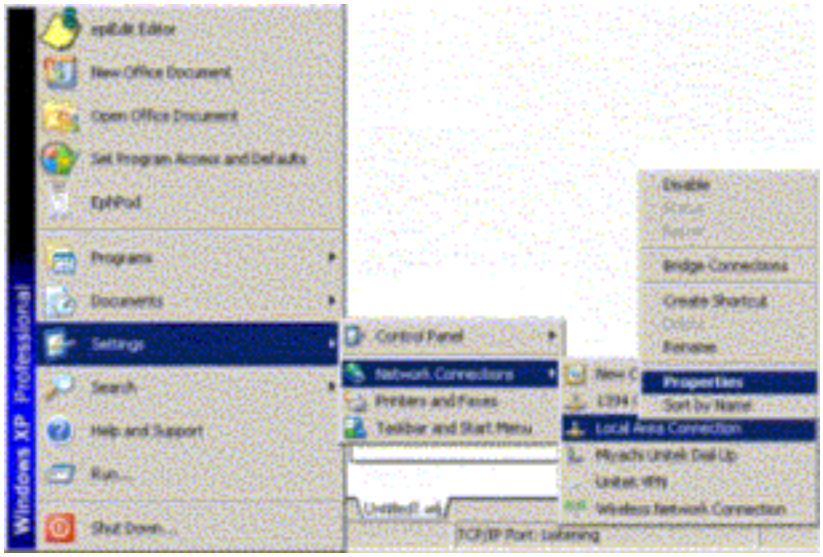




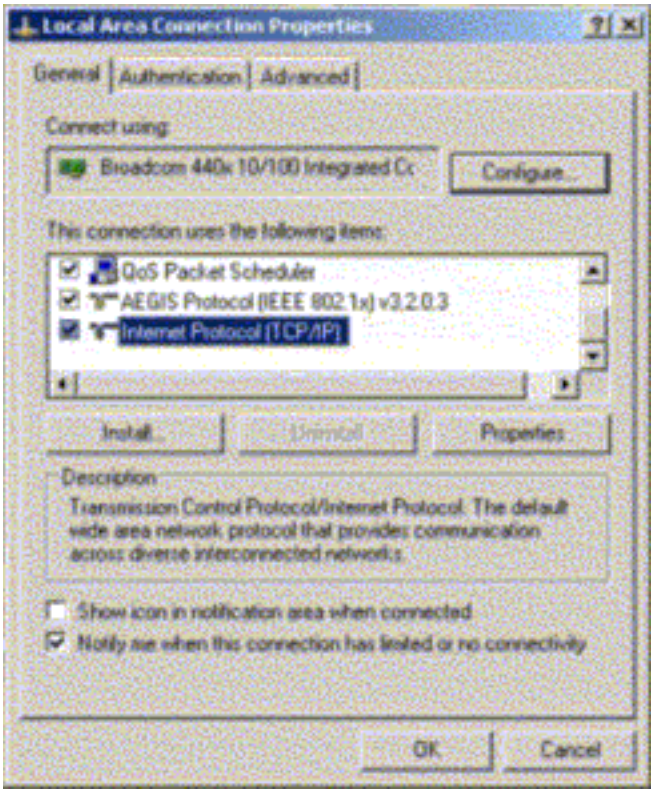
NOTE: When installation is complete you will see the "restart" prompt as shown on the right. Select **No**, because other changes need to be made ***before*** restarting your computer.



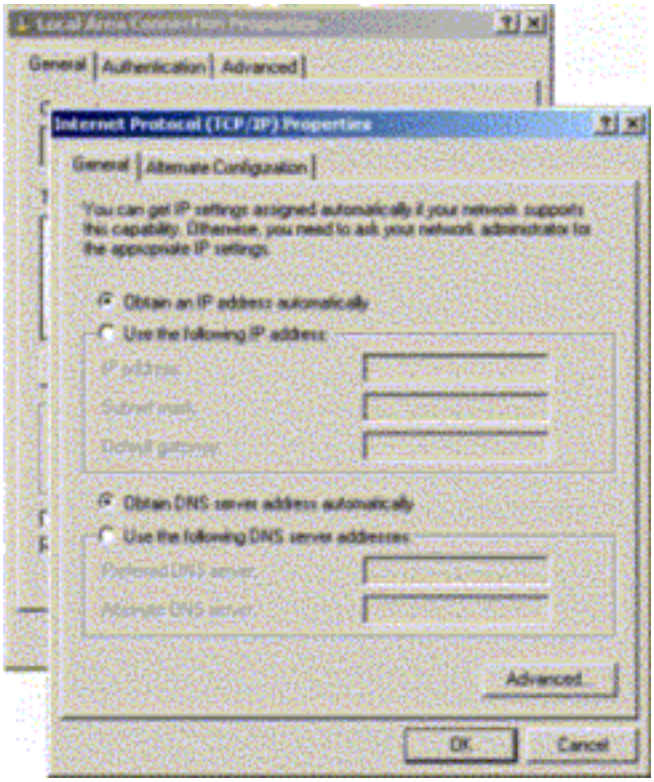
2. Please verify correct network settings. The Marker and Control PC must be on the same subnet for DHCP configuration or the static IP addresses must be assigned and visible.
3. View the properties of the **Local Area Connection**.



4. Select the **Internet Protocol (TCP/IP)** connection and select **Properties.**



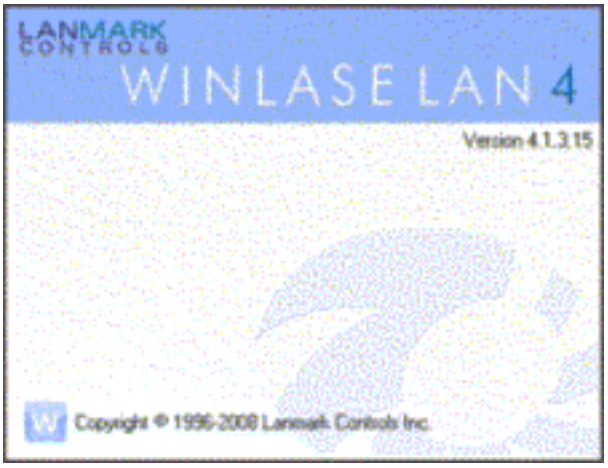
5. If the Marker is connected directly to the PC via a crossover Cat 5e cable, set the PC to obtain the IP and DNS information automatically as shown, followed by **OK**. Otherwise, enter the static IP address (if known).



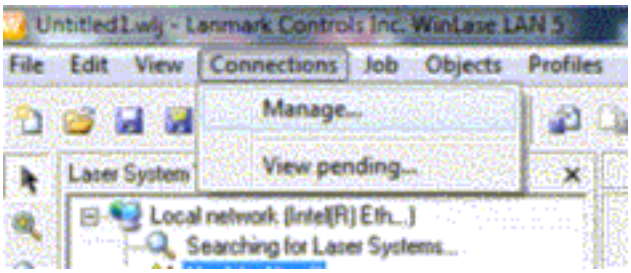
6. Click **Yes** to restart your PC.

7. Restart *WinLase* and turn the Marker ON.

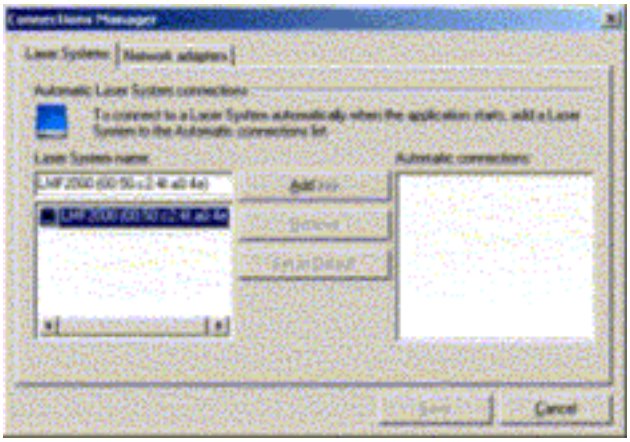
   NOTE: Allow 30 - 60 seconds for the Marker to finish booting and be ready for network operations.



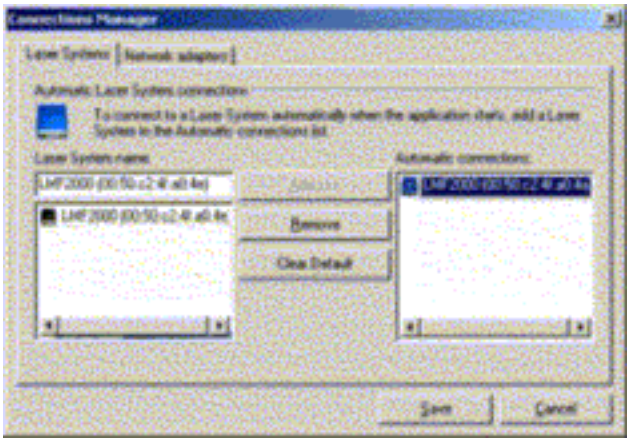
8. Once *WinLase* has restarted, select **Connections > Manage f**rom the **Tools** pull-down menu.



NOTE: If the Marker has booted and the network settings are correct, it will appear under **Laser System name:** in the left hand box of the **Connections Manager**. If the Marker has not completed the boot process you will see **Waiting for system connection** in the window.

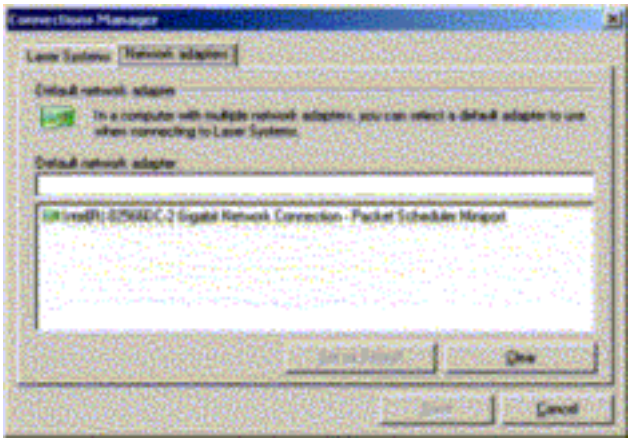


9. Select the appropriate Marker and click **Add >>>>**. If there are multiple devices, choose one and set it as the default device. Click **Save** to save these settings.

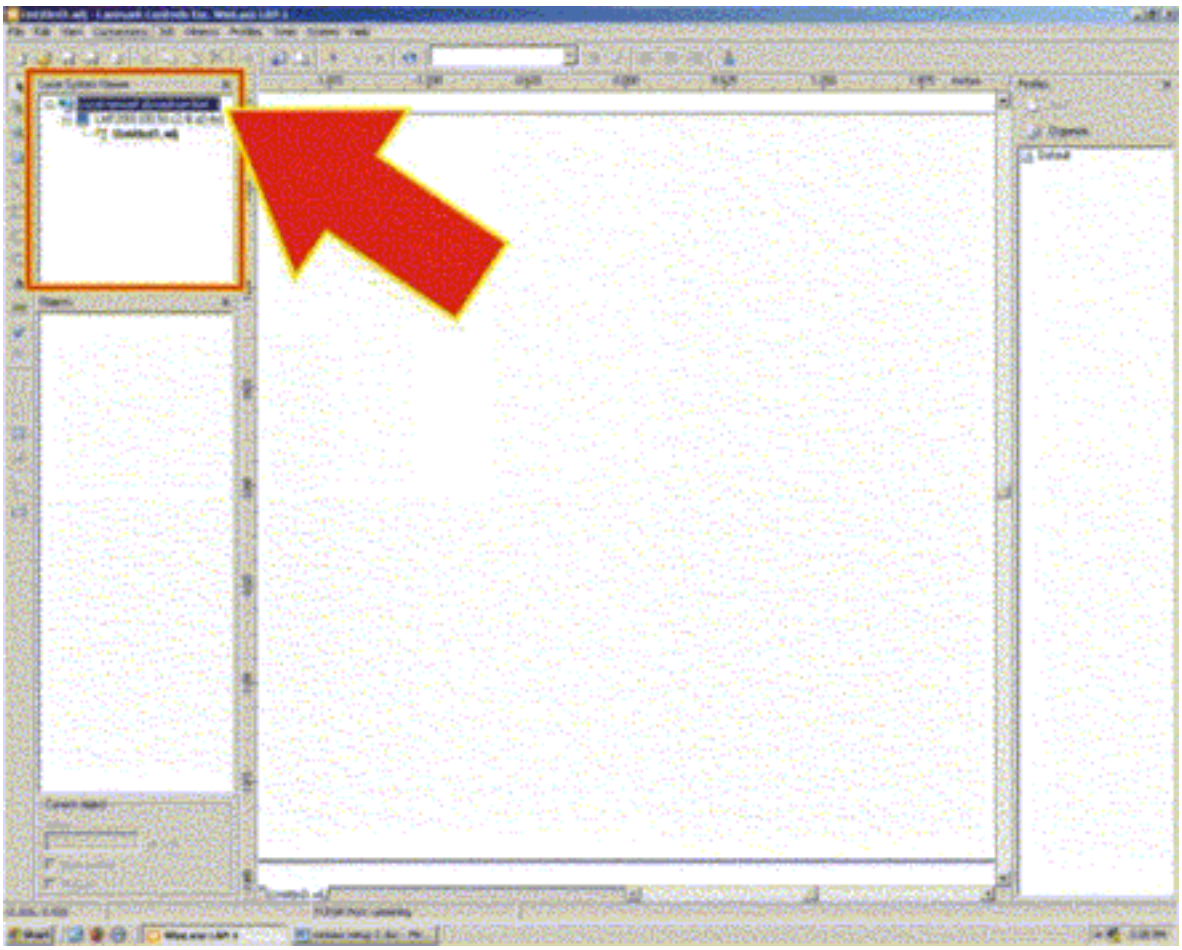


10. If your machine has multiple network adapters and the wrong one appears in the Laser System Viewer, you can use the "Network Adapters" tab in the Connections manager to select the correct default adapter.

    Once the device has been added to the **Automatic Connections** list, a window will pop up indicating the connection status. Please wait until the status changes to **Connected** and the window has closed.



The connected device will be present in the **Laser System Viewer** window in the upper left corner of *WinLase*. A blue icon indicates a TCP/IP connection is present.

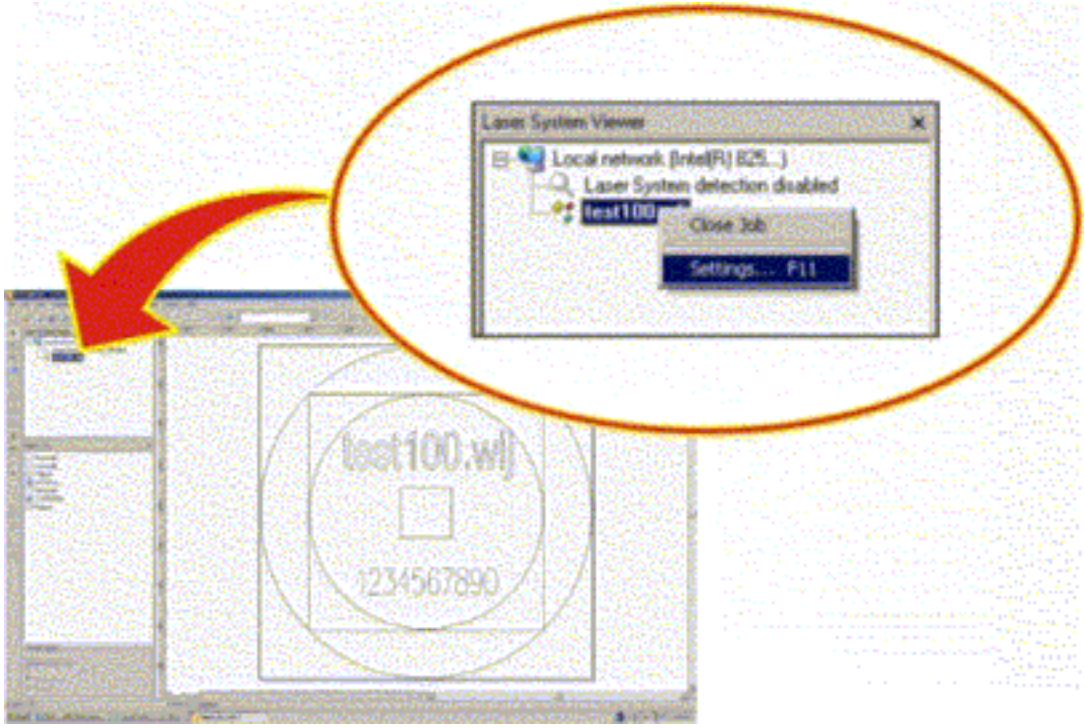


11. Select the **View** pull-down menu, and select a measurement standard.

    You are now ready to create a new marking job and operate the marker. Please refer to the *QuickStart Guide for WinLase* (Amada Miyachi America Part Number 990-550) or the Marker **Help** file for more information.

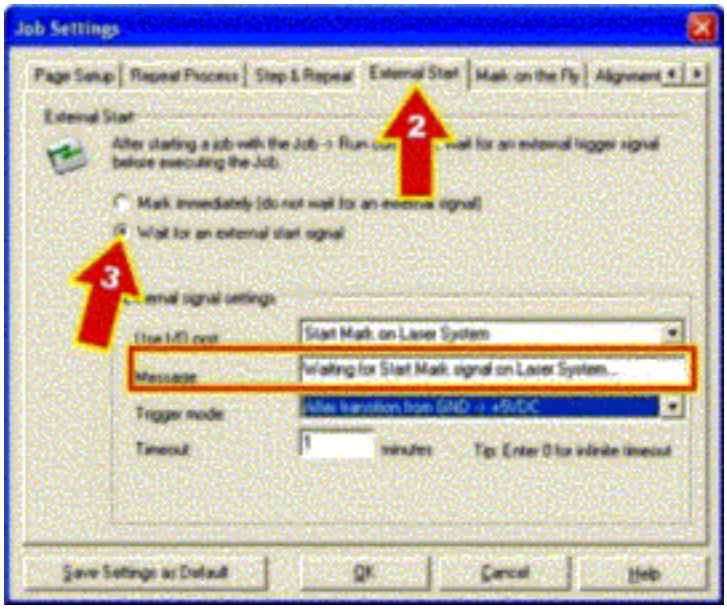
Section V: External Start

1. Right click on the job and click **Settings... F11**.



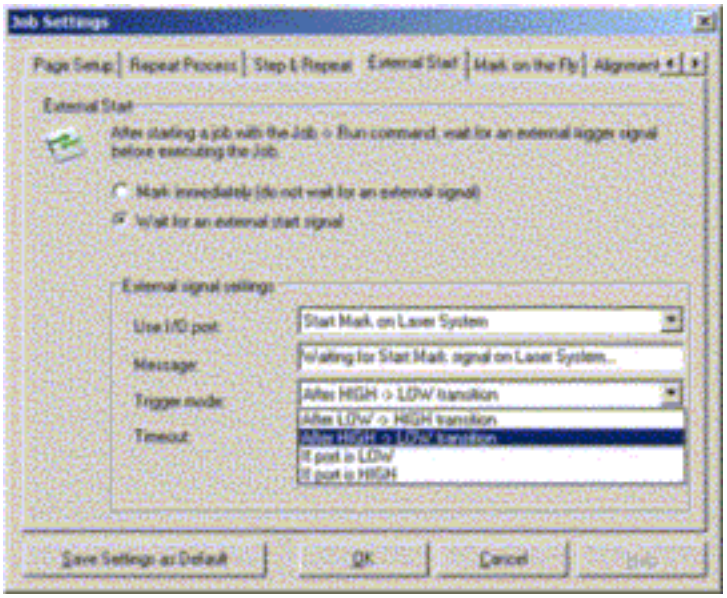
2. Select the **External Start** tab.
3. Click on **Wait for an external start signal**.

   NOTE: You may change the user **Message** if you wish. **Highlight the existing message**, then type in the new message.

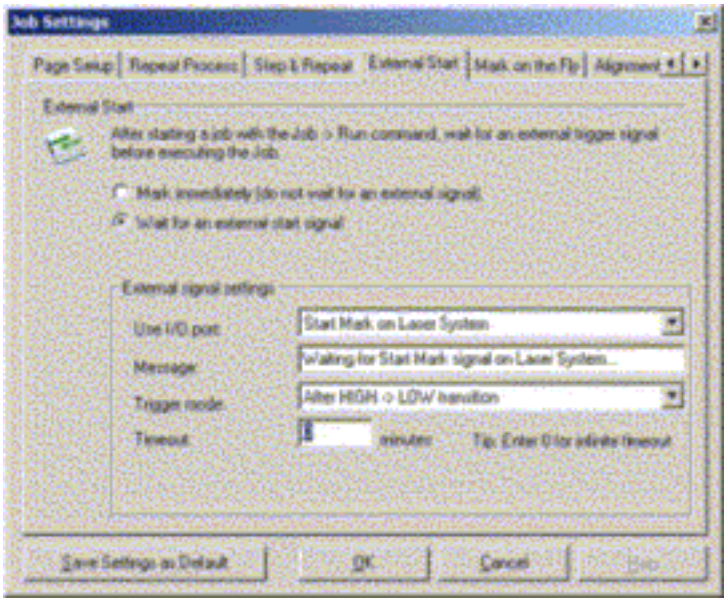


4. Make sure that the **Trigger Mode** is set to occur on a transition, **LOW➔HIGH** or **HIGH➔LOW** depending on if you want to trigger on the rising or falling edge of the input signal.

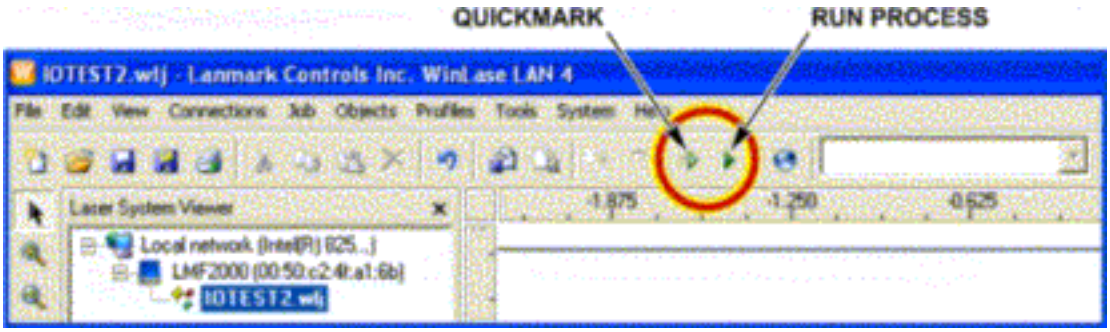
   To change the **Trigger mode**, click on the ▼ arrow, select another mode.



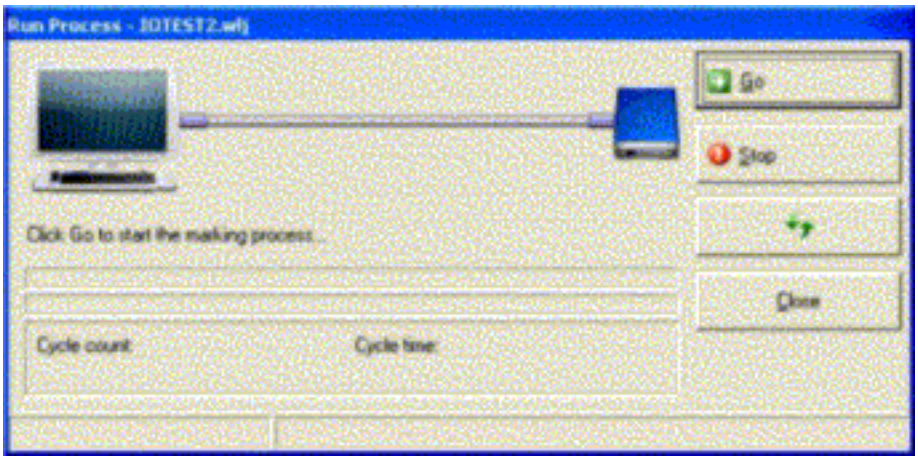
5. You may change the **Timeout** if you wish. Highlight the existing time, then type in the new number of **minutes**.



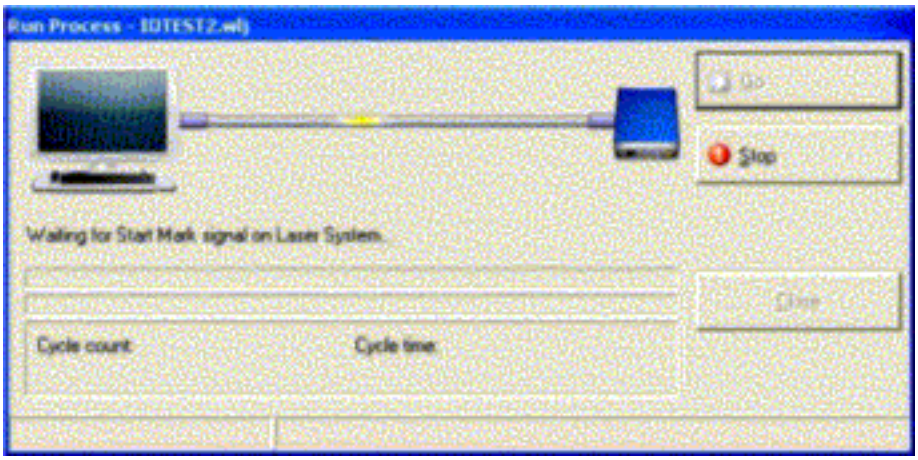
6. After you click **OK**, in the **Job Settings** screen, click on the **Run Process** icon shown below.



7. When you see the screen below, click on **Go**.



8. As soon as you see the **Waiting for Start Mark** message (or your own custom message if you changed it) you may begin marking using your normal external I/O Start Mark signal (foot pedal, START switch, PLC trigger, etc.).

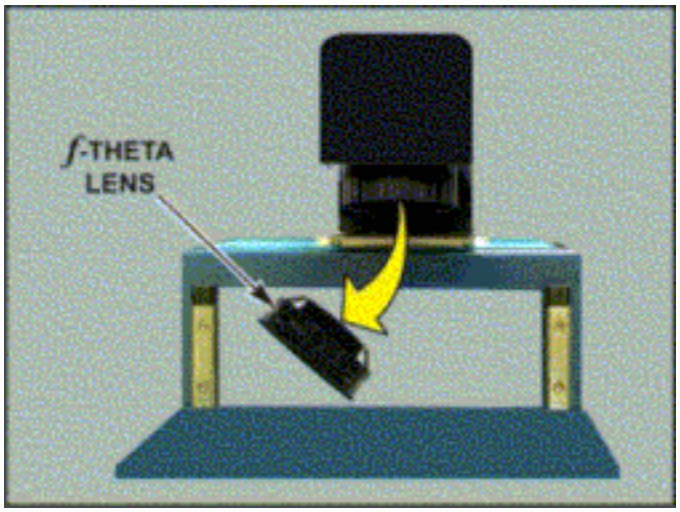


Section VI: F-Theta Lens Configuration

After installing the new *f*-theta lens, select the **System** pull-down menu, select **Preferences**, and select the **Hardware** tab. Select the lens and click **Change** to select the new *f*-theta lens.

It may be necessary to change lens collars when changing lenses. Please refer to the table below.

If you wish to adjust the scaling, rotation, or offset you can click **Calibrate** and follow the instructions provided.



Lens Ring	Amada Miyachi America Part Number "R" Option Scanner (Ex: 8-79-xxR-xxx)	Amada Miyachi America Part Number "B" Option Scanner (Ex: 8-79-xxB-xxx)
100mm Lens Ring	475-468	475-557
160mm Lens Ring	475-468	475-557
254mm Lens Ring	475-471	475-558
420mm Lens Ring	475-471	N/A

See laser marker part number to determine installed *f*-theta lens.

CHAPTER 3
OPERATING INSTRUCTIONS

Section I: Before You Start

Safety Precautions

DANGER

To prevent eye damage when operating this equipment, laser protective goggles must be worn at all times (per ANSI Z136.1). Laser goggles with an OD (optical density) of 7+ (at a wavelength of 1060-1150nm) are recommended or as directed by your LSO.

WARNING

Never operate the Marker in any manner ***other*** than described in this manual. Doing so may expose personnel to laser radiation or electrical hazards.

Before attempting to operate the Marker, have ***all*** personnel who will be working with the Marker read this manual ***and*** the *Laser Safety Manual* (Amada Miyachi America Part Number 990-502) thoroughly.

Notes

- Verify that the electrical supply meets the electrical requirements, as shown in *Appendix A: Technical Specifications*. The electrical supply must meet all applicable local, state, and federal safety standards.
- ***Before*** operating the Marker, be sure the protective lens cover is removed from the output lens.
- Operate the switches and buttons carefully by hand. If they are operated roughly or with the tip of a screwdriver, a pen, etc. they may break or malfunction.

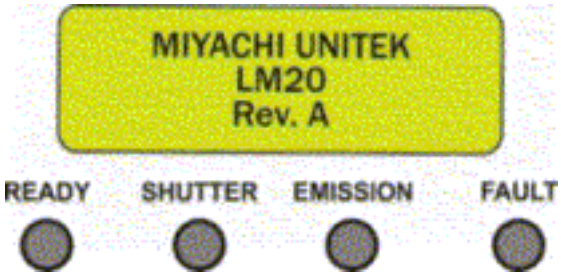
Section II: Operation

To get started operating the Marker following the procedures written in the 990-550 *Quickstart Guide for the WinLase LAN* Software manual. This *Quickstart Guide* only contains brief instructions in order to get you started with basic marking right away. If you need more detailed information or to perform more complicated tasks, please refer to the complete **Software Reference Manual** containing detailed instructions of all *WinLase* features. This Reference Manual is available through Amada Miyachi America. It can also be accessed via the *WinLase* software Help function. Press F1 in WinLase or click **Help > User Guide**.

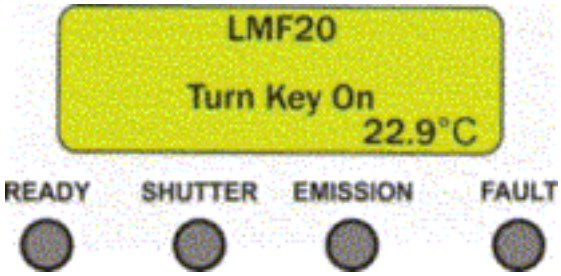
Turning the Marker ON

Verify that the **INPUT POWER SWITCH** on the back of the control is turned ON.

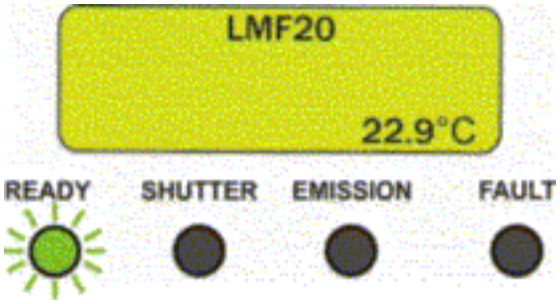
Turn the **POWER SWITCH** on the front of the Marker ON. This will start a series of messages in the LCD Display Screen.



If you see the Turn Key On message, turn the SYSTEM ENABLE key switch ON. If the key switch was already ON, this message will not display. The temperature displayed is the laser module diode temperature which will only be available on –HP models.

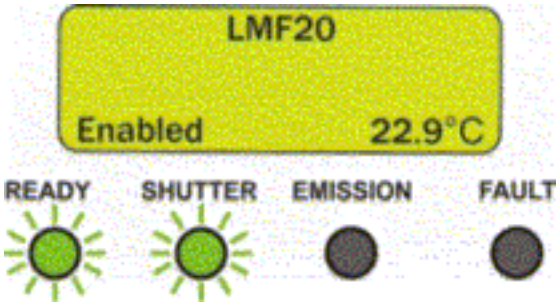


Once the laser controller has booted and obtained an IP address, and if no faults are found, the Ready LED will illuminate.

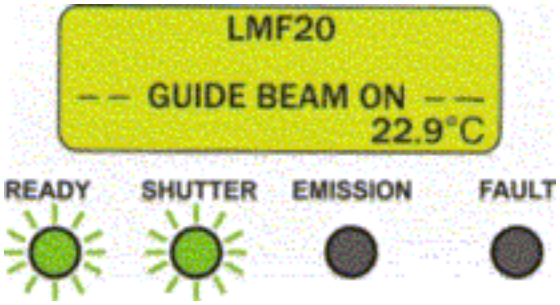


When the shutter I/O is enabled, the key is on, no faults exist, and the interlock input is closed, the shutter will open and the Shutter LED will turn on.

When the Enable I/O input is activated Enabled will be visible on the screen. If Enabled is not visible, the laser cannot emit.

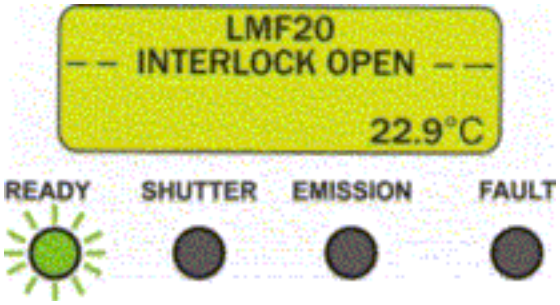


When the **GUIDE BEAM I/O** input is enabled the guide beam will turn on and the **GUIDE BEAM** message will be displayed. Laser radiation is not possible while the **GUIDE BEAM** is on.



When the interlock inputs are opened the Interlock Open message is displayed.

NOTE: If laser emission is in progress and the interlock is opened the laser will go into a fault state and the LCD will display an **ILOCK** fault that must be reset.



Initiating an Emergency Stop

To cause an Emergency Stop, either press front panel **EMERGENCY STOP** button, ***or*** open the **E-STOP** contacts on the back of the laser. This condition will immediately de-energize the safety contactors that and power down the laser module as well as close the safety shutter. This will make the fiber laser marker safe and a fault will be declared on the Emergency Stop controller LEDs visible on the front of the Safety Box. The emergency stop output contacts will open.

An Emergency Stop can also be initiated by opening the dry contact closures on the laser rear panel I/O. This allows external automation equipment to initiate an emergency stop. Verify that the external equipment is properly integrated as described elsewhere in this manual.

Clearing an Emergency Stop

Clearing an Emergency Stop can be performed by cycling the front panel key switch or sending a Reset I/O signal to the Fault Reset input on the back of the laser marker. Before this reset can be accomplished the safety controller inputs must be closed. This can be as simple as turning the Safety Box front panel

EMERGENCY STOP button clockwise to release it or as complicated as clearing the automation equipment E-Stop allowing the dual channel external contact closure inputs to close.

If the Emergency Stop occurred because of a failure of one channel then both channels must be opened and closed in tandem. This can be done by pushing the front panel emergency stop button and releasing it or using external automation equipment to do the same using the external inputs.

Opening the Remote Interlock

To open the remote interlock, remove the dry contact closures from Interlock Channel 1 and Channel 2. The fiber laser marker safety shutter will close and all laser jobs in process will be stopped, and a fiber laser marker fault will occur if a job is in process. The front panel LCD will display an error message if a fault has occurred or otherwise indicate **INTERLOCK OPENED**.

Closing the Remote Interlock

To close the remote interlock, close the dry contact closures across Interlock Channel 1 and Channel 2. The interlock controller will reset automatically. The fiber laser marker safety shutter will open and the laser can again be used for processing if no faults are present. It may be necessary to clear the Interlock software error if using the fiber laser marker in standalone mode or reset the Interlock hardware error on the fiber laser marker itself if a laser job was in process when the interlock occurred.

E-Stop Faults

There are a couple common reasons why an Emergency Stop condition cannot be cleared. See *Chapter 4, Maintenance* for details if further troubleshooting of the safety controller is required.

1. The front panel **EMERGENCY STOP** mushroom button is depressed. Rotate the switch slightly clockwise to release.
2. An **EMERGENCY STOP** mushroom button is pushed elsewhere in the system.
3. Emergency Stop Input Channel 1 or Input Channel 2 dry contact closures open.
4. Emergency Stop Input Channel 1 or Input Channel 2 not closed at same time. Close channel 1 and channel 2 within 250ms of each other.
5. Short across channel 1 and channel 2 input contacts. Verify the wiring.
6. Damaged emergency stop safety controller. This will be present if the **Fault** LED is illuminated but no other faults are present. The safety controller will need to be replaced. This can be caused by applying any voltage or current input to the Interlock channel 1 and channel 2 pins. Use a dry contact closure only.
7. Welded contacts in AC output contactor(s) that control the laser power supply. The faulty contactor will need to be replaced before the system can be reset.
8. Faulty Reset switch or circuitry.

Interlock Faults

There are a couple common reasons why an Interlock condition cannot be cleared. See *Chapter 4, Maintenance* for details if further troubleshooting of the safety controller is required.

1. Interlock Input Channel 1 or Input Channel 2 open.
2. Interlock Input Channel 1 or Input Channel 2 not closed at same time. Close channel 1 and channel 2 within 250ms of each other.
3. Short across Interlock Input Channel 1 and Channel 2 input contacts. Verify the wiring.
4. Damaged interlock safety controller. This will be present if the **Fault** LED is illuminated but no other faults are present. The safety controller will need to be replaced. This can be caused by applying any voltage or current input to the Interlock channel 1 and channel 2 pins. Use a dry contact closure only.

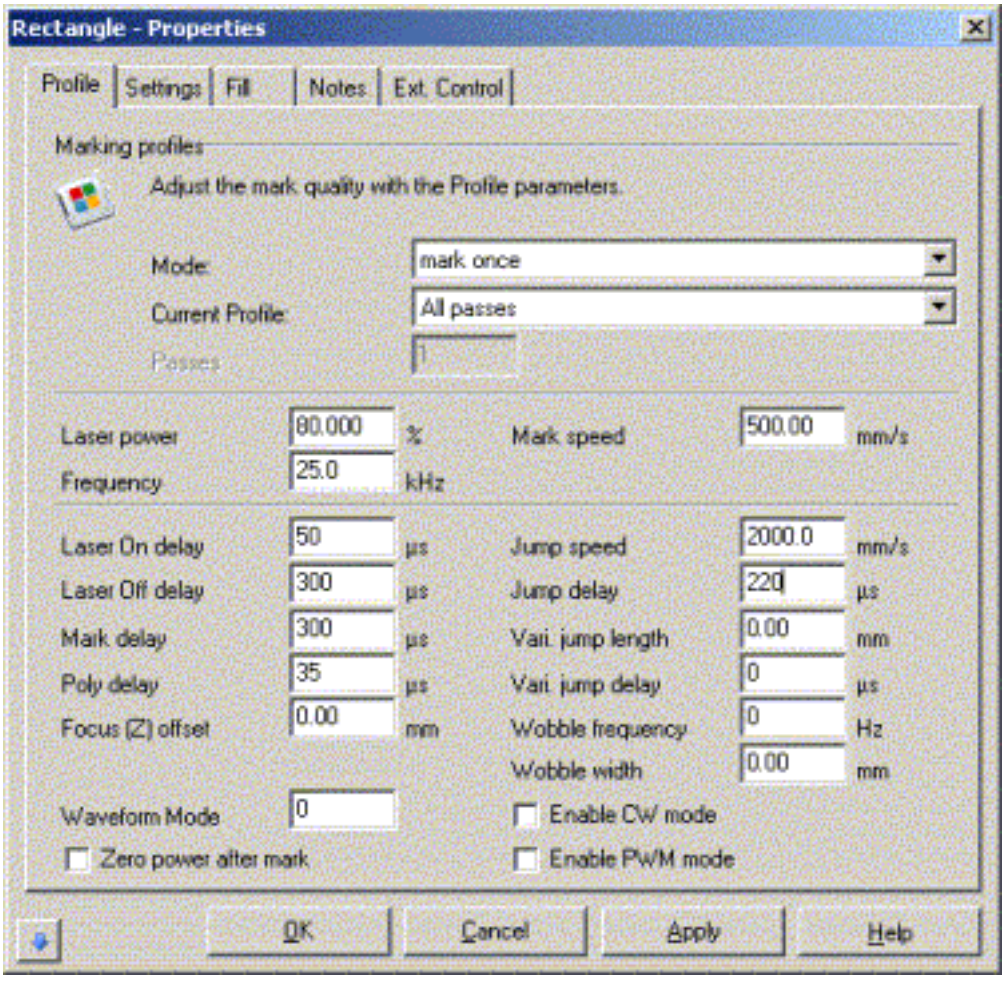
Section III. Process Parameters and Development

Setting up Laser Parameters

Correctly configuring the laser mark parameters can be the difference between a fast, high quality laser mark and poor results. The purpose of this section is to illustrate certain laser marking parameters that are important to the process. For a detailed description of each field and setting please consult the *WinLase LAN* software manual.

The properties window Profile tab is where parameters are set. Each object has its own individual laser marking parameter set that must be configured either individually or by applying a previously configured Profile to one or more objects. The properties window can be accessed by double clicking on the object in the Object List or right clicking on the object in the mark field and selecting “Properties”.

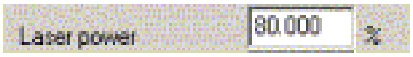
Spot Size Optical configuration is also important for good process results and must be selected before optimizing laser system parameters.



Primary Laser Parameters

The most important laser properties that must be configured are Power, Frequency, Mark Speed, and for –HP and –SM lasers, Waveform Mode. These parameters control how much heat is put into the laser and under what circumstances that heat is applied. These parameters are chosen based on the intrinsic characteristics of the material and desired mark appearance.

Power



Power is the parameter that determines how much optical power the laser delivers. 0-100% corresponds to the full power range of the particular laser. Laser output power is not necessarily linear – 50% setting for a 20W laser is not necessarily 10W. Also, total measured output power is affected by the laser pulse and waveform settings.

Frequency

The laser Frequency is the number of pulses per second that the laser outputs. Each pulse shape is controlled separately by the Waveform setting for –SM and –HP lasers. Non-HP or -SM lasers like the LMF50 are Q-switched and this frequency setting controls the pulse width as well. The frequency range for each laser model can be found in *Appendix A, Specifications.*

Mark Speed

Mark Speed is the speed at which the laser beam moves across the part while the laser is on. This is the third primary parameter that controls the laser mark. If the speed is too high for a given power the mark will be light or nonexistent, whereas if it is too slow the processing speed will not be optimized and the part can be overheated, burned, or set on fire.

Waveform Mode

Waveform Mode, or Selectable Pulse Width, is a parameter of –HP and –SM lasers that allows the user to independently configure the pulse width with respect to frequency. This is important for marking delicate materials such as plastics with good contrast. Waveforms with long pulse widths are a good match for low frequency etching and marking of metals while waveforms with short pulse widths are good for plastics, annealing of metals that require controlled energy but lower peak power, and other cases. Although there are some “peak” frequency/waveform combinations that optimize laser power the best marking results are sometimes found using other combinations of parameters. Amada Miyachi America can help optimize laser settings for any material.

Refer to *Appendix C* of this manual for further details on specific pulse width and frequency combinations for each laser model.

Secondary Laser Parameters

Secondary Laser Parameters are those related to steering the beam and optimizing the mark throughout the process for best throughput with acceptable appearance. These parameters are chosen based on the performance of the galvanometer scanning unit, the response time of the laser output to on/off commands, and the Mark Speed. Most of these settings need to be optimized for each process especially at higher mark speeds. At lower mark speeds galvanometer characteristics like settling time and laser delays can be mostly ignored but they become quite significant as speeds increase. Burned spots at the beginning or end of line segments, missing beginning or ends of line segments, excessive mark time, etc are all symptoms of poor tuning of secondary laser parameters.

Generally the sign of well tuned secondary mark parameters are marks that are uniform with no variations of intensity with well shaped start/stop points.

Laser On Delay

The Laser On Delay is used to control the laser mark at the beginning of each vector. This delay is a period of time that is characteristic of the laser and mirror configuration. The time value specified controls how long before the laser is turned on that the mirrors need to start moving to correctly begin the vector. Setting the Laser On delay correctly synchronizes the laser output with the beginning of the vector movement executed by the mirrors.

If the Laser On Delay is too short the mirrors will take too long to start moving after the laser turns on and the result will be a burned spot.

If the Laser On Delay is too long the mirrors will begin moving before the laser is outputting energy and some part of the vector will be unmarked.

50-80µs is generally a good starting point for this value. The delay can be positive or negative.

Laser Off Delay

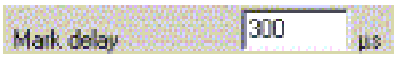
The Laser Off Delay is used to control the laser mark at the end of each vector and prevent burn effects. Most lasers emit for a brief period of time after they are commanded to shut off. The Laser Off delay is used to command the laser the laser to turn off just before the mirrors reach the end of a mark vector. This ensures that that the laser mark stops where it is supposed to stop.

If the Laser Off Delay is too short marking will stop too soon and the vector endpoint will be missed.

If the Laser Off Delay is too long marking will continue after the mirrors stop and a burn-in point will occur at the endpoint of the vector.

200-300µs is generally a good starting point for this value.

Mark Delay



Mark Delay is the delay at the end of a line segment that allows the mirrors to complete the move to the required position prior to executing the next mark command. This is therefore more important for marks with many discontinuities during the process and less important for marks with few discontinuities or short jumps.

Too long of a Mark Delay does not adversely affect the mark quality but will affect cycle time by making the process increase longer.

If the Mark Delay is too short the mirrors will begin their jump before completing the previous vector segment.

150-300µs is generally a good starting point for this value.

Poly Delay

Poly delay is the delay inserted between two sequential vectors. The minimum delay allows enough time for the galvos and mirrors to catch up with the command signal before a new command is issued to mark the next segment.

If the Poly Delay is too long there will be laser burn-in at the vector junctions.

If the Poly Delay is too short the junction will not be well formed as the beam takes a “short-cut” and rounds the corner.

30µs is generally a good starting point for this value.

Focus (Z) Offset

This parameter is used with focus heads with a programmable focus axis. It is not used for standard two dimensional marking.

Jump Speed

Jump Speed is the speed at which the galvo mirrors move when not marking laser segments. Typically this is very rapid. High Jump Speeds shorten overall process time while lower Jump Speed settings can add to overall process time. Increasing Jump Speed has the disadvantage of increasing the required settling delay at the end of each jump so it is advisable to optimize this parameter with the rest of the delays for best overall performance.

Jump Delay

Jump Delay is the amount of time the mirrors are allowed to settle at the end of a Jump. Matching Jump Delay to Jump Speed is required for fast and accurate marking. Optimizing Jump Delay involves balancing appearance requirements with overall cycle time. Depending on the overall mark it can sometimes be faster to choose a moderate Jump Speed with a moderate Jump Delay over an extremely rapid Jump Speed with a very long Jump Delay. The Jump Delay is applied for all jumps large and small.

If the Jump Delay is too short the marking will start before the mirrors are settled causing bad mark appearance as the laser marks outside the desired area. This is usually seen as a defect at the beginning of a sequence of vectors.

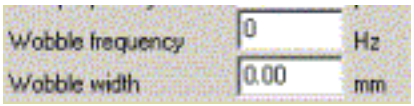
If the Jump Delay is too long there will be no visible effect on the mark but the overall cycle time will increase.

Jump Delay is related closely to Jump speed. 400µs Jump Delay for 2000mm/s Jump Speed is a good starting point.

Variable Jump Parameters

Variable Jump is similar to the standard jump delay but can be configured to occur when a move occurs over a specified distance. In this manner it is possible to have two separate jump delays, one for short moves that require less settling time and one for longer moves that require more settling time.

Wobble



Wobble is a method of increasing the perceived thickness of a vector segment. When a Wobble frequency and width is selected the galvo mirrors will perform tight circles at the set parameters along the vector path, effectively widening the laser mark footprint. Wobble is an excellent addition to single stroke text or other marks. When using wobble it is important to be sure that the overall galvo speed including both the wobble and vector mark speed do not exceed the overall speed limit.

If the wobble frequency is too low or the width is too high it may be possible for the wobble action itself to be visible to the eye when looking at the mark. Wobble is most effective when the frequency is high and the width is very low.

Enable CW Mode

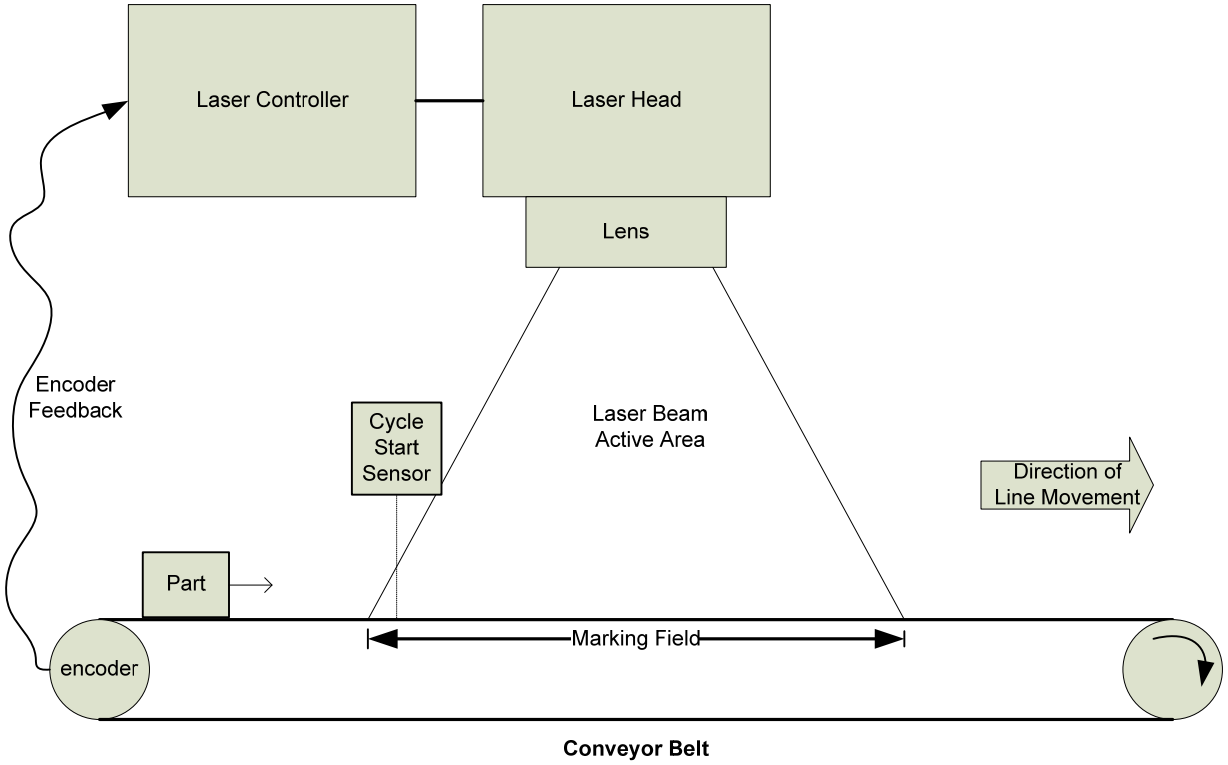
CW mode is available on –HP and –SM laser models. When CW mode is selected the frequency and waveform settings are ignored.

Section IV. Marking On the Fly

Mark on the Fly (MOTF) is a feature that allows for laser marking to take place on a continuously moving work surface. MOTF requires an encoder input to the laser marker software to provide part position. As a part is passing underneath the laser lens through the work area, the incremental encoder movement is applied to the required galvo position, thus steering the laser beam onto the correct location. It is possible to trigger marking jobs using either a start mark input just like normal operation or using a distance-based trigger based on encoder counts. It is also possible to use a combination of these triggers.

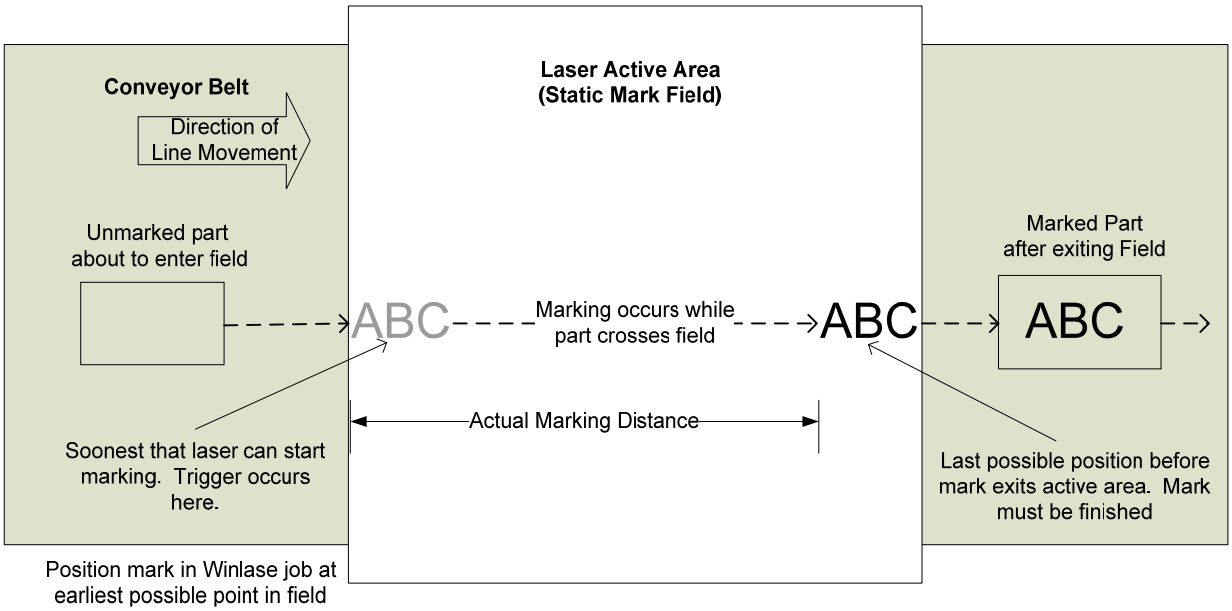
The laser marker is capable of marking on parts moving on conveyors oriented 0, 90, 180, or 270 degrees with respect to the standard un-rotated mark field. Due to the speed that vector math must be performed during high speed mark on the fly operations the encoder input can be applied to one galvo axis only and therefore other angles are not supported.

Front View of Typical Mark on the Fly Configuration



Top View of Basic Mark on the Fly Process

In a basic MOTF process the mark is triggered by a sensor detecting that the part to be marked has crossed into the area that the laser can mark. The process is then started and the laser marks the part until the mark is complete. The mark must be complete before the part exits the laser active mark field area.



Basic Speed Calculation

It is necessary to first develop and optimize the laser mark in a static situation before maximum line speed can be calculated. Once the best case static mark is found the mark can be adapted for dynamic operation on the line.

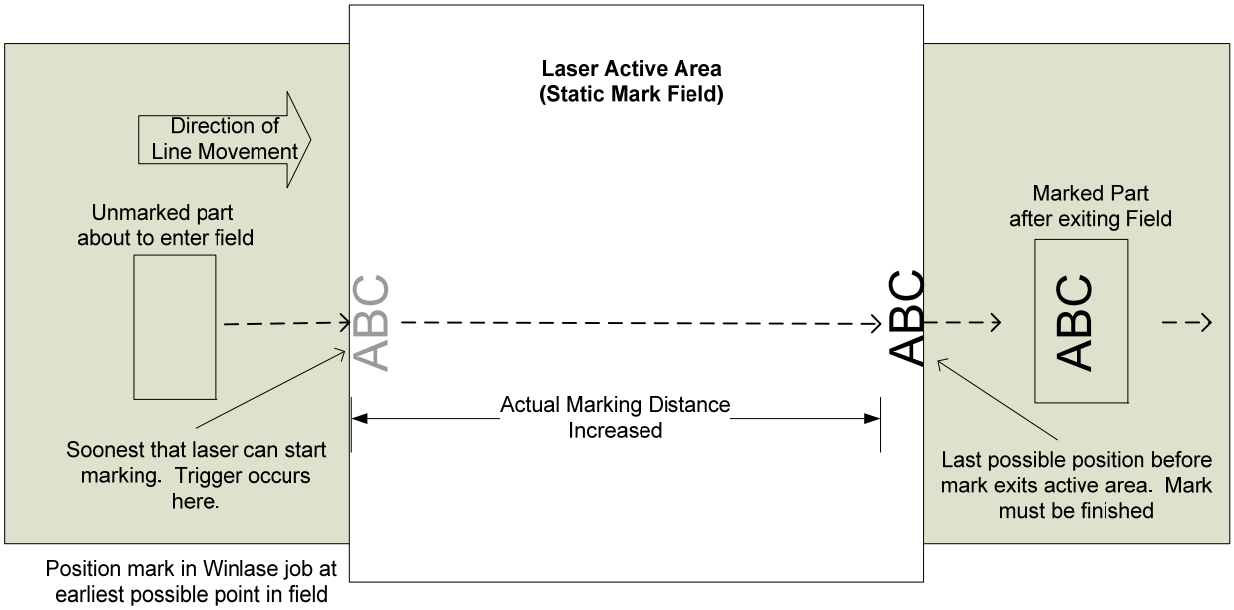
The equation for maximum line speed is:

$$\textit{Line Speed Max} = \frac{\textit{Actual Marking Distance}}{\textit{Mark Time}}$$

To increase the maximum line speed it is therefore necessary to increase the actual marking area size or decease marking time for each mark. By increasing the actual marking distance it is possible to use a slower mark setting for the same overall line speed.

Often it is possible to increase the actual marking area size by changing the orientation of objects or modifying the order in which they are marked to increase efficiency. One particularly effective tactic in high speed applications is to orient the mark so that the laser beam forward progress is opposite to the direction of line movement.

Optimized version of Basic Process



Determining Minimum Spacing

It is often necessary to achieve a certain part throughput rate to meet production requirements. The minimum spacing often dramatically reduces the actual marking area available and requires process optimization to hit a certain line speed.

The actual marking distance is not the only component that determines the minimum distance that parts can be spaced for a given process cycle time and line speed. There is some overhead time needed to allow for CPU processing and the time required for the laser beam to jump back from the final marking position of the last part to the first marking position of the next part. During this overhead time before the laser is in position and ready to mark the next part, the line is still moving and thus some distance is "lost" forever to the process. This time is on the order of milliseconds but for extremely fast line speeds this can be an important factor.

Distance Lost to Overhead = (Jump Time x Line Speed) + (CPU Processing Time x Line Speed)

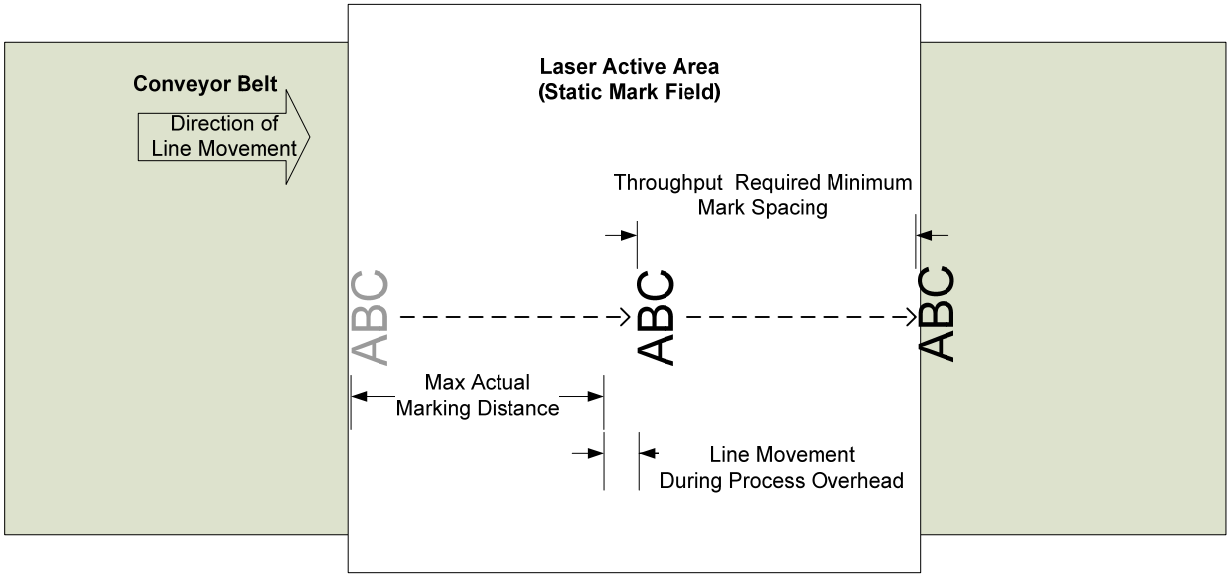
Adding together the actual marking distance and the distance lost to overhead for a specific line speed and process time gives us the smallest possible spacing between one part and the next.

Minimum Part Spacing = Actual Marking Distance + Distance Lost to Overhead

The most generous situation is one where the minimum part spacing is equal to the full-field Actual Marking Distance from our basic example. Each part has exactly one full laser field to complete the mark and therefore the minimum part spacing would be approximately the size of the laser field. This is rarely the case in real life and the minimum mark part spacing is usually the main factor that determines whether or not a Mark on the Fly application can meet a given process speed.

If the mark completes in less time than the line takes to cross the minimum spacing distance, it will be ready to go again and can be triggered either by a distance trigger to maintain minimum spacing or a sensor trigger when the next part arrives depending on the machine configuration.

Minimum Part Spacing



Position Based Triggering

There are two ways to indicate to the laser that a part is both in position and ready to go.

1. Standard cycle start input controlled by a sensor appropriate to the application
2. Encoder distance-based triggering

The user can program a set triggering distance and the system will attempt to meet it. To work properly the system must have finished the previous mark and finished the overhead operations before the encoder count trigger is activated. If these conditions are met the laser will mark on the correct interval spacing. Otherwise the laser will conclude the laser mark and overhead and will immediately start marking the next part. In this situation the spacing will become larger as the line speed increases. The change from exact spacing to "as fast as possible" spacing will occur at the point at which the required distance to complete the entire mark sequence is equal to the distance requested by the encoder trigger.

One last possibility is to combine the cycle start trigger and the encoder distance trigger for applications where the sensor can't be located within the laser field and must trigger at a known distance before the part arrives at the point where the mark commences.

Encoder Selection

Encoders must use 5V differential quadrature outputs with A and B channels. One recommended model is the ***AMCI Duracoder DC25F-B2NPGRMDE NEMA25*** shaft style encoder. Another recommended model is the ***BetaLaserMike Laserspeed4000-1*** laser encoder for high speed high accuracy line speed measurement. Wiring details can be found in *Appendix B, Electrical and Data Connections* of this document.

Determining Feasibility

Not every process is compatible with MOTF. For the process to work a balance of mark time, line speed, process settings, throughput, and mark design must all work together. Static process development and up front calculations are the most important steps that must be performed to determine if the process is compatible with MOTF before the time and expense of an integration onto a line.

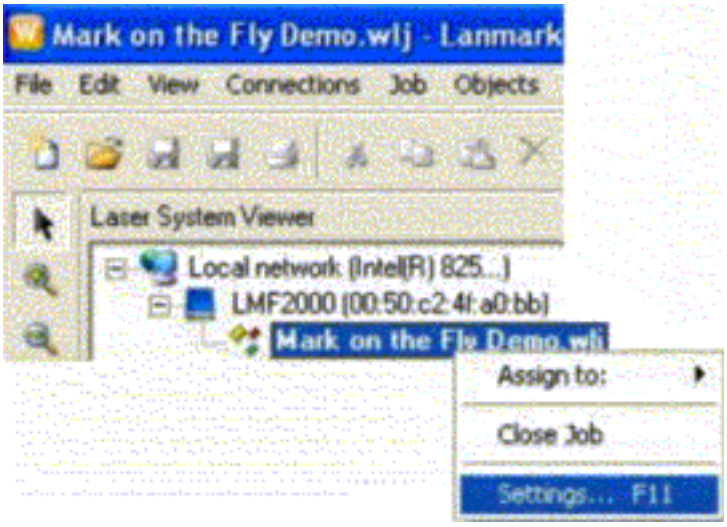
As a general set of guidelines to determine if a process is compatible, follow these steps:

1) Develop the mark on a static workpiece and optimize every setting for best possible performance.
2) Consider MOTF in the mark time when designing the mark and optimize direction of mark so that the laser moves generally in one direction as opposed to skipping back and forth. This will give the MOTF more time to work on the active area.
3) Once the best possible cycle time is determined calculate the best case line speed and compare with expectations.
4) If the best possible line speed based on actual mark area is within reason, consider minimum spacing and triggering requirements.
5) Test on a line simulator or integrate into a real assembly line

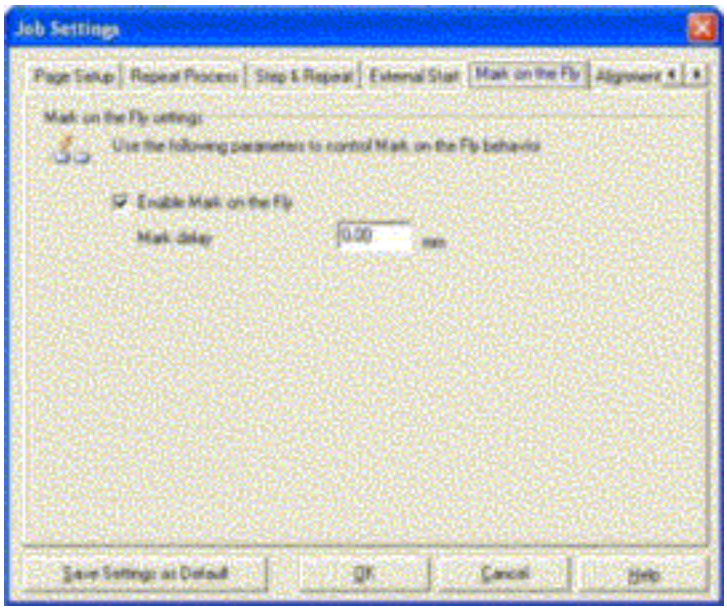
Finally, there is no substitute for experimentation when optimizing a MOTF process. Once it is possible to test on a real line the optimizations made at the static stage can be massaged and improved to increase performance and margin of safety.

Job Configuration for Mark on the Fly

1. Configure **Mark on the Fly** settings. Right-click on a job in the **Laser System Viewer**.
2. Click on **Settings**.

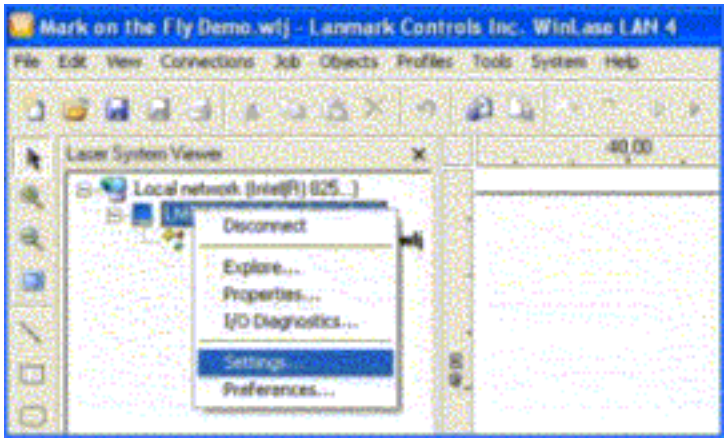


3. Click the **Enable Mark on the Fly** checkbox option from the **Mark on the Fly** tab.
4. Enter a **Mark delay** in millimeters of workpiece travel if desired.



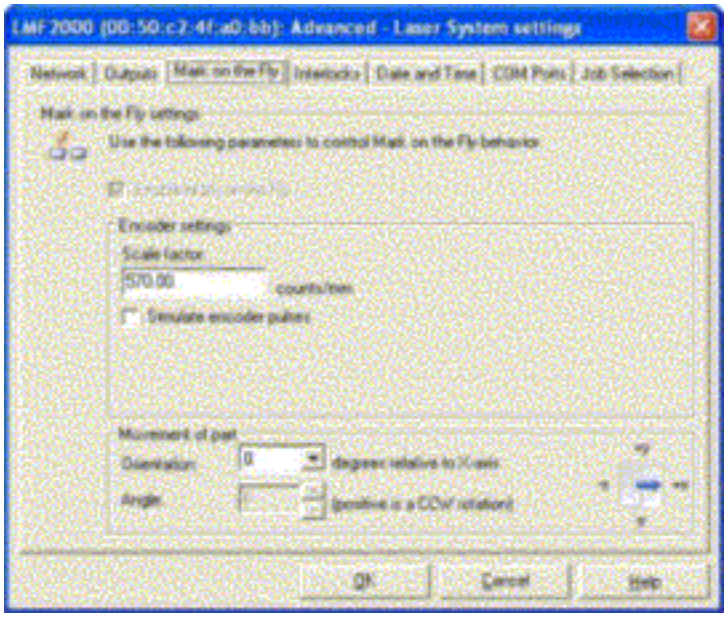
System Configuration for Mark on the Fly

1. Right click on the marker in the **Laser System Viewer** then click on **Settings**.



2. Select the **Mark on the Fly** tab.
3. Set a **Scale factor** for the optical encoder by setting the orientation of the part relative to the marker's X-axis then calculate the **counts/mm** of your equipment. Orientation of the part movement is extremely important so that the encoder correction is applied to the correct axis in the correct orientation. This setting uses the same reference direction as the lens calibration.

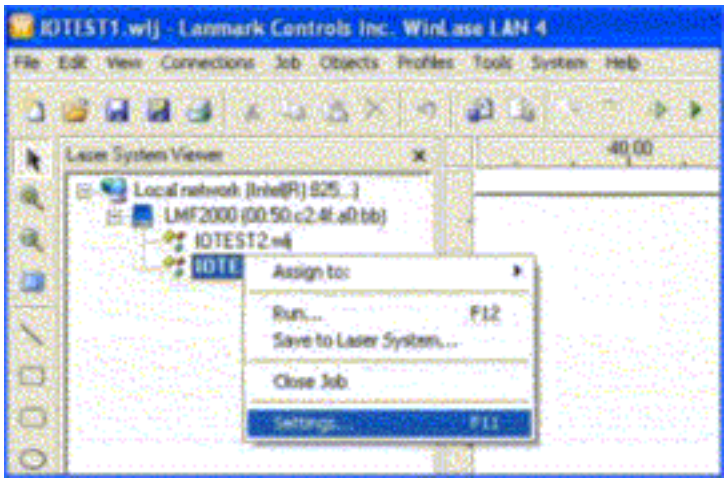
   NOTE: If you wish to use a simulated encoder (***not*** recommended), use the **Simulate encoder pulses** checkbox to configure the simulation, then click **OK** when finished.
4. Configure the job start as explained in *Chapter 2, Section V: External Start.*



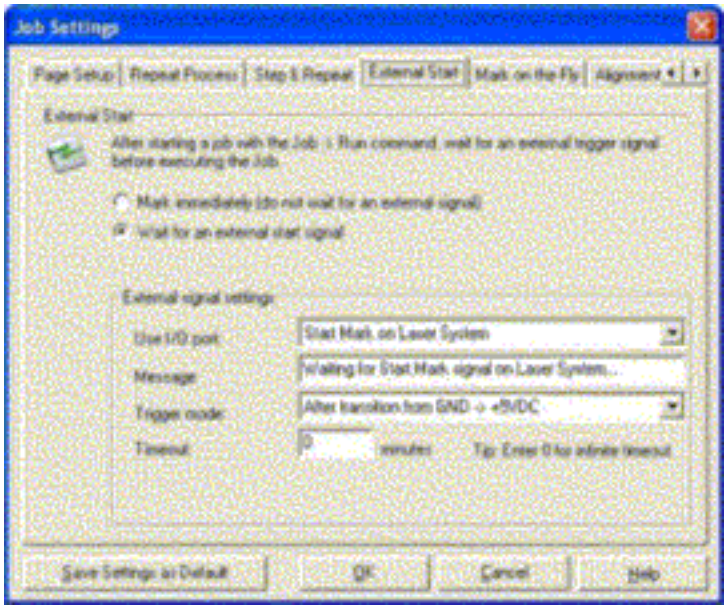
Section V. I/O Job Selection Configuration and Use

Set up the external start requirements for the jobs you wish to load over I/O.

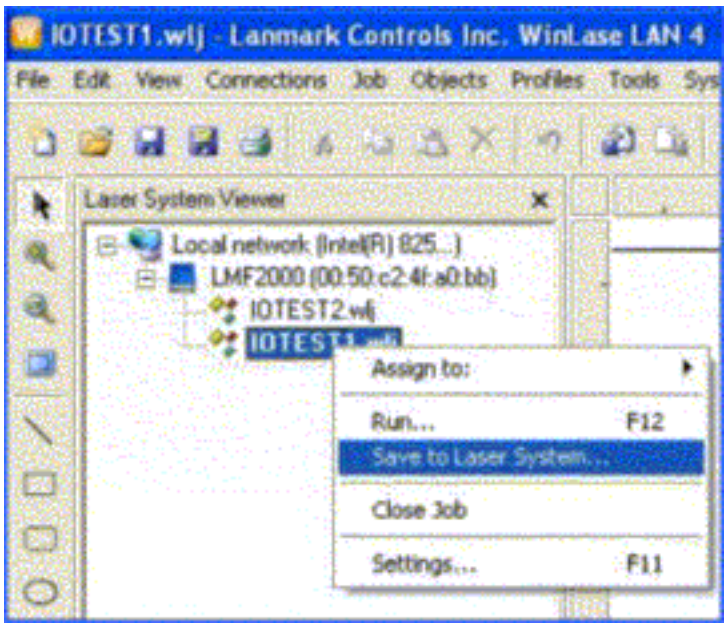
1. Right click on the job file, and click **Settings**.



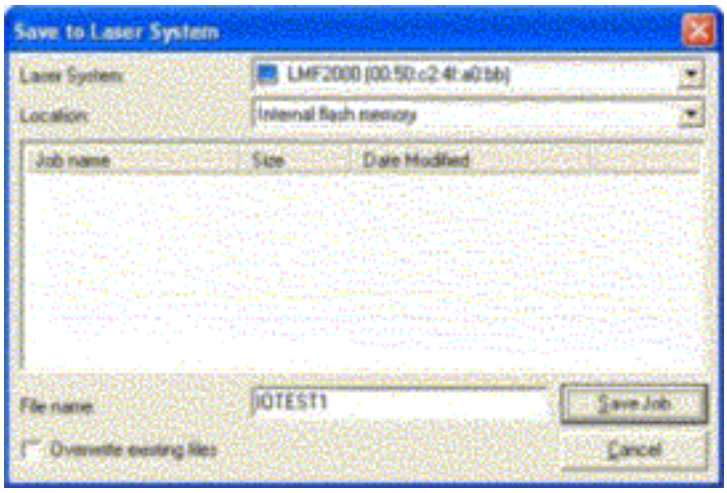
2. When you get to **Job Settings**, click on the **External Start** tab, then select the parameters you want for your marking job.



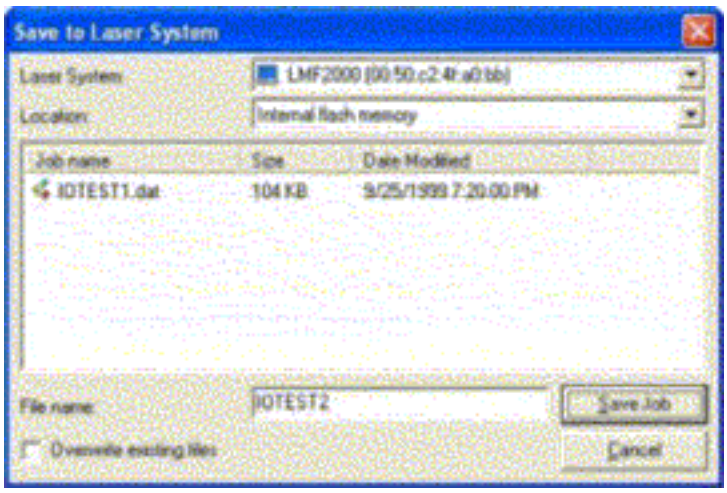
3. To save the job(s) to the laser internal memory, right click on the job, and click **Save to Laser System**.



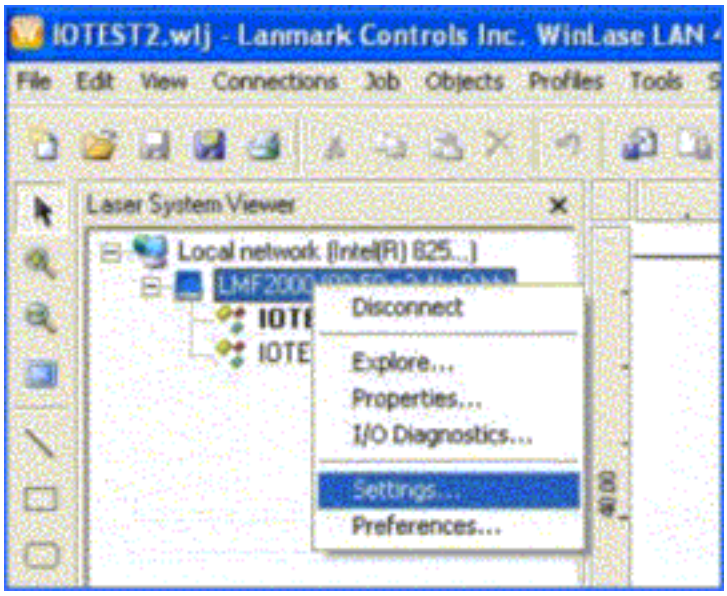
4. If you want to change the name, go to **Location** and select either **Internal flash memory** or **USB memory stick.**
5. When the memory you want displays, go to **File name:** and type in the name for the file, then click on **Save Job**.



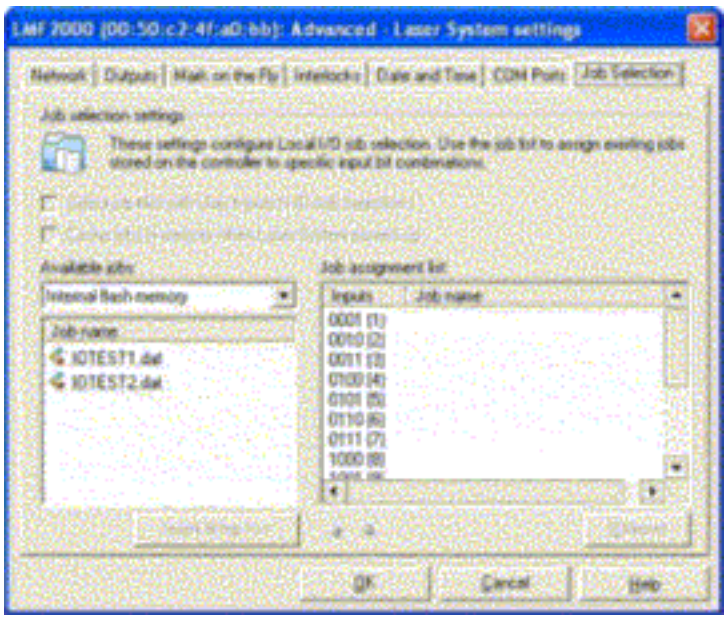
6. Repeat Steps 1 to 5 for all the additional jobs you want to store.



7. To enable **I/O Job Select**, right click on the marker, then click **Settings** to get the **Advanced-Laser Systems settings** menu on the next page.

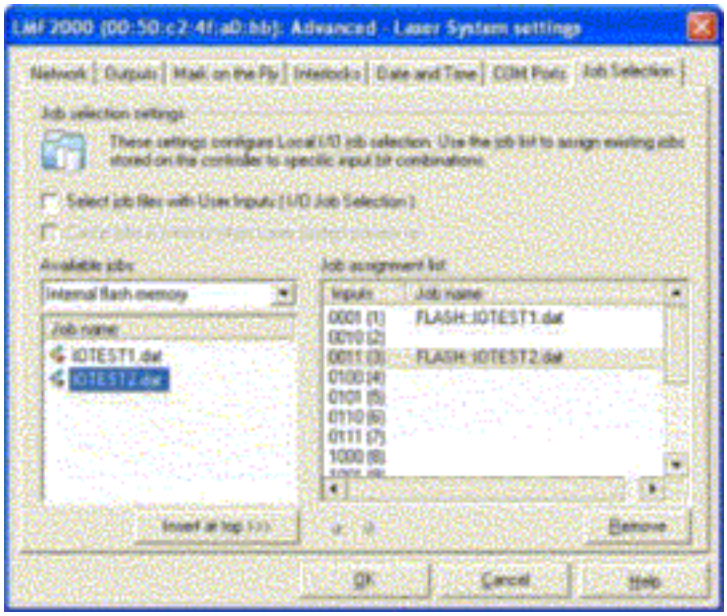


8. From the **Advanced-Laser Systems settings** menu, click on the **Job Selection** tab.

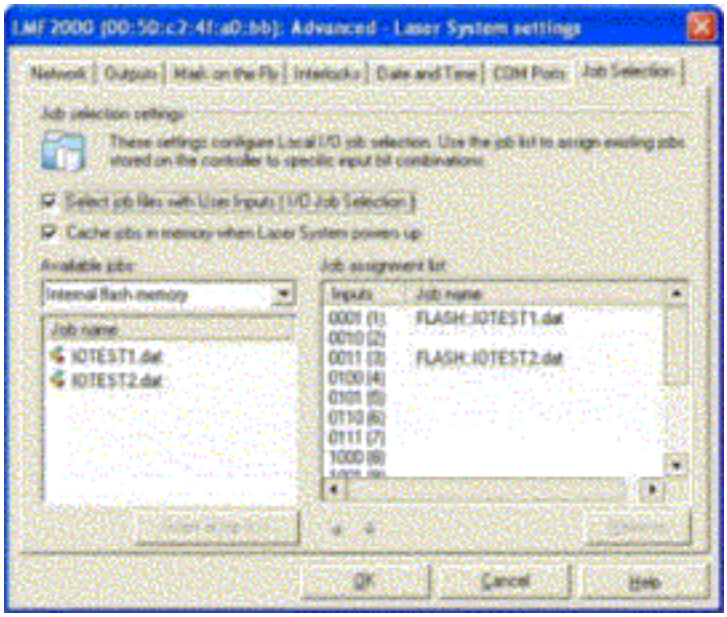


9. Drag the jobs into the list on the right of the screen, or use the **Insert at Top** button.

   NOTE: The "input" code shown is the binary input combination that selects this job. This will be four or eight bit depending on the version of laser marker used.



Once the jobs have been assigned, decide whether or not you wish to use **Cache jobs in memory when Laser System powers up.** This cached mode loads jobs in <50ms. The disadvantage is that this mode stores all jobs into RAM. If there is more job data than available RAM an **Error** will occur.

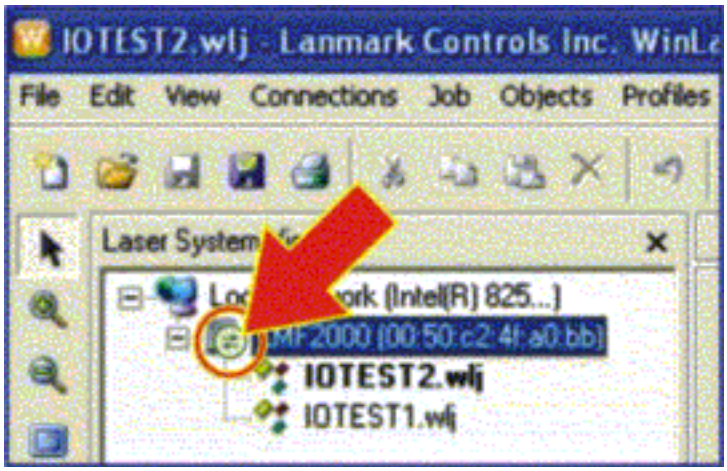


Not selecting Cached job load mode will allow use of all laser memory, but jobs can take longer to load. Typically it is best to use Cached job load mode and keep the job size down so that the 10MB of RAM is not used up. Typical job files are only 100kB, but large files such as Bitmaps can use a great deal of memory.

10. Click **Select job files with User Inputs (I/O Job Selection)** and click **OK** to enter **I/O job** mode.

NOTE: The laser icon in the upper left will change first to a Down arrow (downloading jobs into RAM) and finally to an icon showing two arrows pointing in opposing directions (right). This means that you are ready to select a job using the input bits on the back of the unit.

Please refer to the timing diagrams in *Appendix B, Electrical and Data Connections, Section II, Timing Diagrams* to operate in I/O job selection mode.

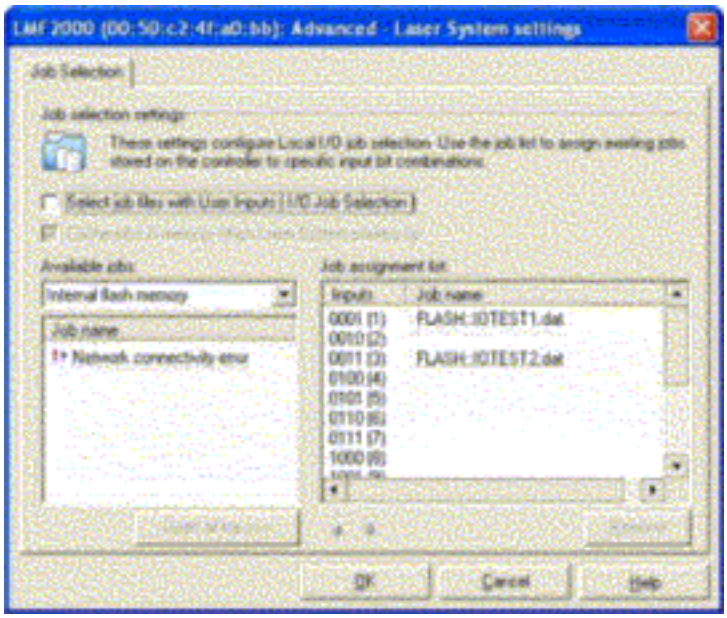


How to exit I/O Job Selection Mode

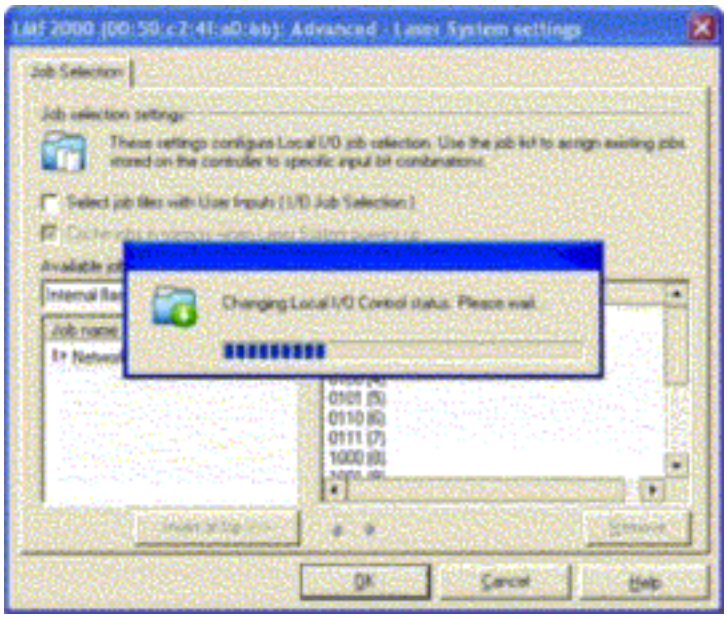
1. To exit I/O Job Selection mode, right click on the laser in **Job Select** mode and click **Settings**.

2. You will be warned that any in-process job will be aborted. Click **Yes** to proceed

3. Uncheck **Select job files with User Inputs (I/O Job Selection)** to exit this mode.



NOTE: The unit will process the change, and return you to the main **WinLase** screen where you can control the marker as usual.



Section VI. Vector Node Editing (*Graphic File Editing*)

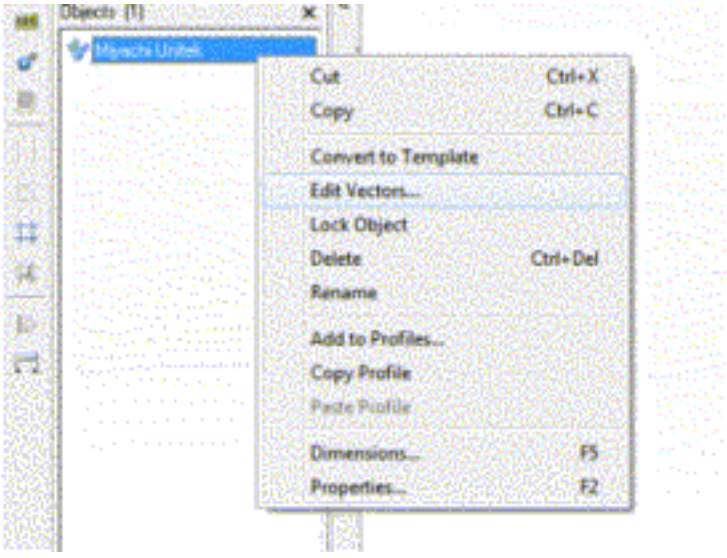
Vector Node Editing (also known as *Graphic File Editing*) is a feature that allows the user to modify, repair, and optimize vector artwork for improved marking. Using the Vector Edit Tool, users can add and remove nodes, change the order of marking, repair polylines and optimize fill, break artwork into multiple pieces, assign different sections of artwork to different laser parameters, and combine multiple vectors into single artwork files.

Vector Node Editing operations are performed on WinLase Object files (*.WLO). WLO files are WinLase's native vector artwork format. When importing external artwork in other formats like .DXF, .AI, .DWG, .PLT, .DXF, etc. the WinLase importer tool converts the original file format into the native WLO file format. In addition, the WLO files can be exported as .PLT files to be used by other software.

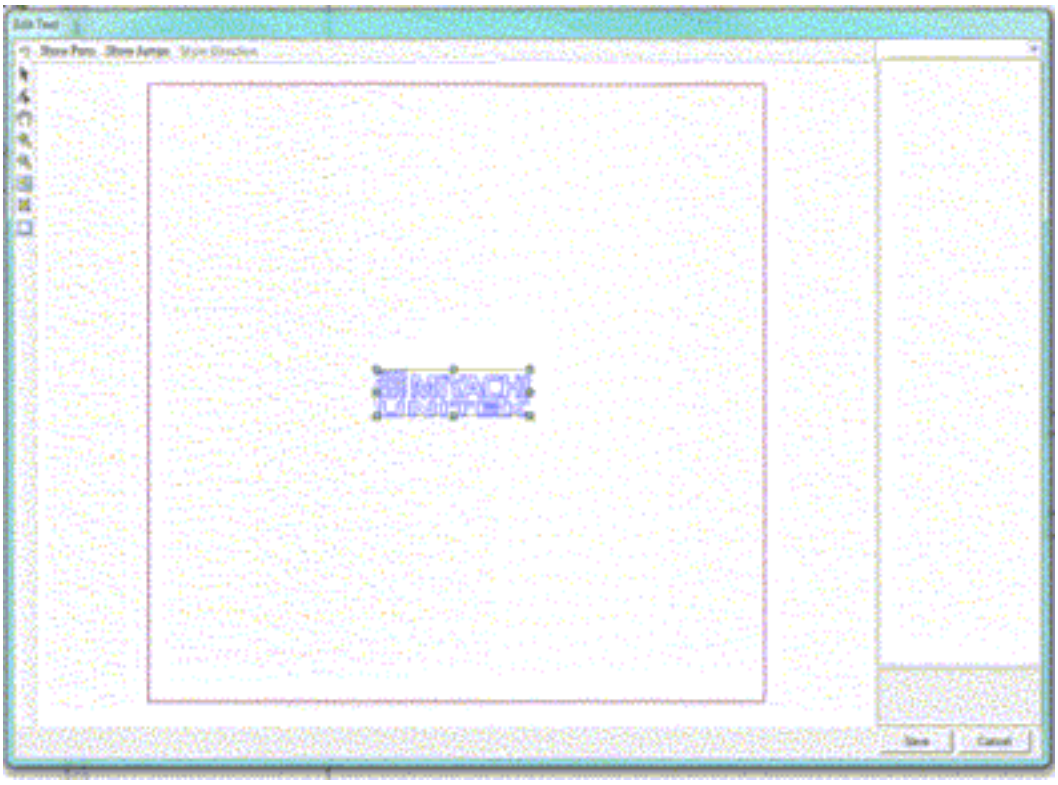
Vector Node Editing is a CPU-intensive process due to the number of vector calculations that must be performed. Vector artwork can have many nodes. Although artwork with many vectors can be imported and manipulated, to ensure good performance the editor selection tool (mouse selection box) is limited to selecting 1000 nodes at a time. When creating or importing artwork, it is helpful to minimize the number of unnecessary nodes and vectors. Each node in a laser marking process introduces delay so an optimized artwork file with a minimum number of nodes can mark much faster than a file with many unnecessary nodes while ending up with the same result.

Accessing the Vector Edit Tool

The Vector Edit Tool is accessed in a separate window launched from within the WinLase object screen by right-clicking on a vector object and selecting "Edit Vectors". It can also be launched by right clicking on the artwork in the WinLase mark field screen and using the context menu. The object must first be selected before the Edit Tool can be launched. The Edit Tool can be resized by dragging the corner or boundary lines.



The Edit Tool Window and Icons



Select

Select is used to make groups of vectors active. When a group is selected a square with grab handles will be visible and the group can be moved and stretched as desired. When a graphic is first opened by the edit tool it will be selected by default.

Edit Nodes

The Edit Nodes tool takes a selected group of vectors and makes each individual node available for editing

Grab

Grab is used to move the entire working area around in the field of view without causing the artwork to change position with respect to the coordinate system of the edit tool.

Zoom In

Zoom In allows the user to make the artwork larger on the screen. To use the zoom in tool the user draws a selection rectangle around the desired field of view and the edit tool work area will zoom to the best fit that accommodates the desired rectangle. The user must draw a selection rectangle to zoom, simply clicking on the zoom in button will not cause the field of view to change. The user can also zoom in using the mouse wheel.

Zoom Out

Zoom out steps the zoom level back by a fixed amount. This amount is not changeable. The user can also zoom out using the mouse wheel.

Zoom to Objects

Zoom to objects causes the zoom area to encompass all objects in the field.

Zoom to Selection

Zoom to Selection zooms to fit the selected objects on screen.

Zoom to Field

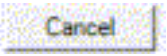
Zoom to Field zooms out to fit the entire field in the work area.

Undo

While editing nodes a single level Undo is available. It is not available in the Select screen of the Edit Tool while moving objects. It is important to save work frequently back to WinLase to avoid loss of work.

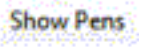
Save

Save takes the changes made in the Edit Tool and returns back to the WinLase editor. Changes made are applied to the WinLase object and a new WLO file is created in the working folder.



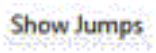
Cancel

Cancel discards all changes and returns to the WinLase GUI.



Show Pens

Show Pens causes the artwork to be displayed using the color of each segment's pen parameter. Pens allow the creator of the artwork or someone editing it for use with laser marking software to specify a different set of laser parameters for different segments of the same artwork. Each laser parameter setting group is called a pen, and each vector has a pen attribute. A laser object can be configured to ignore pens and mark the entire object using one set of parameters or each pen can be given a unique set of laser settings. Each pen has a unique color, and Show Pens toggles the display of these colors on or off.

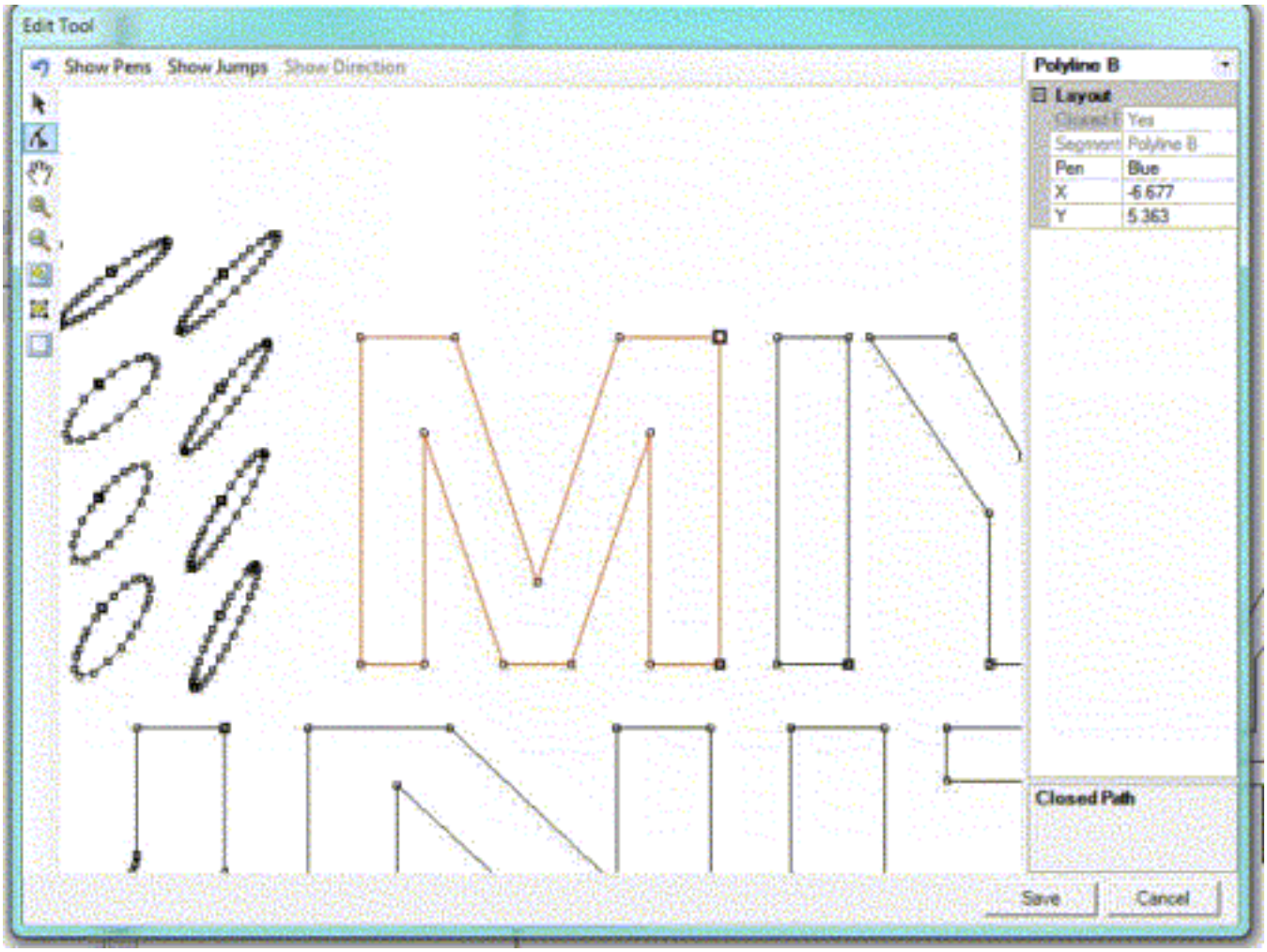


Show Jumps

Show Jumps causes the vector jumps to be displayed on the screen. Jumps are vector movements of the laser galvanometer head while the laser is turned off. Every polyline or individual vector has a jump as the first movement so the laser beam can begin marking the vector or polyline.

Editing Nodes

When an artwork object is selected and the Edit Node button is selected, the node display will appear. Each node is indicated by a square. The size of each node indicates different things about the node itself. Clicking on a node opens information about that node on the right side of the screen. The information displayed will be different depending on whether or not the node is a part of a polyline



PolyLines

Polylines are a series of vectors marked sequentially end to end without jumps in the middle. At each node a Poly delay will occur before the laser moves to the next vector segment.

A polyline is considered "Closed" if the first node (Jump) is at the same coordinate as the last node (Polyline C). For a section of artwork to be filled by WinLase's Hatch Fill function it is required that all polylines in the artwork are closed. By far the most common cause for artwork that doesn't fill correctly is unclosed polylines. It is often required to go through each polyline in a piece of artwork and verify that the "Closed Path" attribute is Yes, indicating that it will fill as a closed path.

If multiple closed paths are nested within each other it will alternate hatch filling and not filling the closed paths. It will fill the outermost object, not fill the next one inside the outermost, then fill the next closed path, etc.

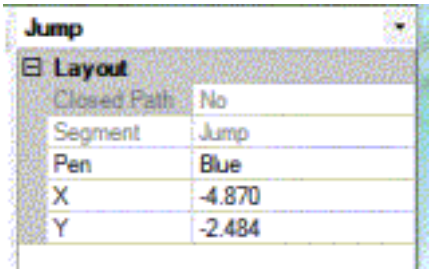
Note that the name of the node indicates the type of operation that happened to get to that node – Jump means that the laser has jumped to that point, Polyline C means that a Polyline C segment preceded that node, etc.

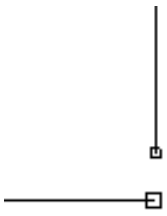
Polylines always exist as a series of connected nodes in the following order:

Jump ➔ Polyline A ➔ Polyline B ➔ ….. ➔ Polyline B ➔ Polyline C

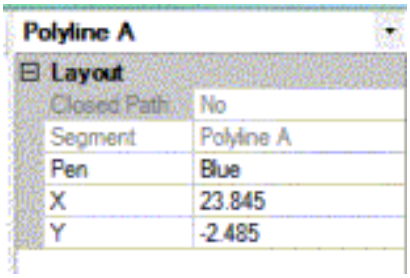
The first line of the information window will give you information on the type of node selected – the choices are:

Jump – A Jump indicates that the laser beam will jump to this point and turn on the laser and mark to the first A segment. A Jump vector is indicated by the "Jump" name in the first line and the Segment display. Also, a Jump is indicated by a large square when the vector is not selected and a filled large square when selected.

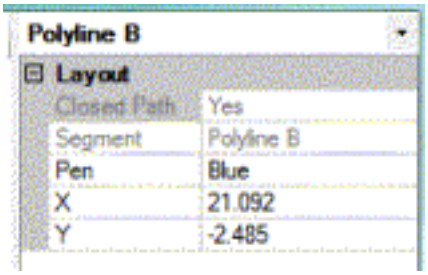




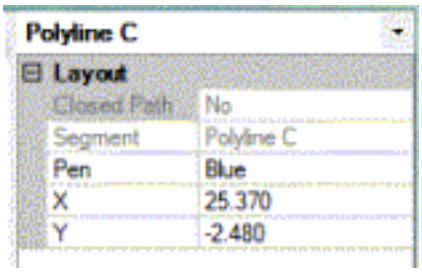
Polyline A – A Polyline A node always occurs after a jump. If you delete a Polyline A node the next node after the jump will become an A. There is only one Polyline A node in each polyline. Polyline A has the same appearance when selected and unselected as B and C when displayed on the screen.

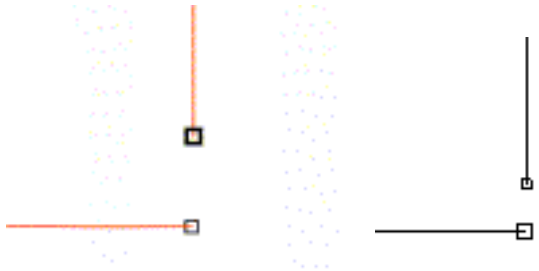


Polyline B – Polyline B segments comprise the bulk of the polyline. Every "middle" node in the polyline is a Polyline B. Polyline B nodes have the same appearance when selected and unselected on the screen as Polyline A and C nodes.

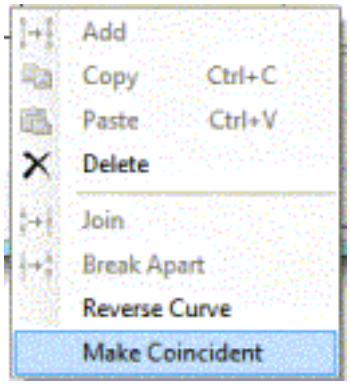


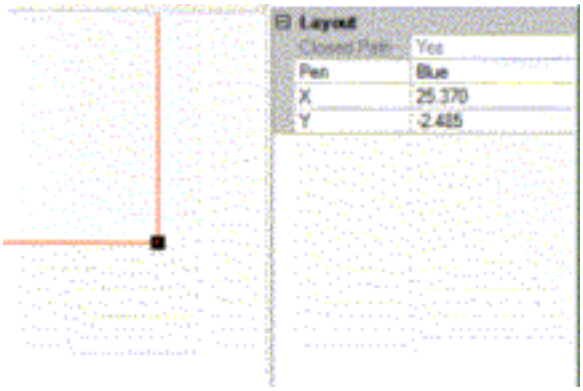
Polyline C – A Polyline C node indicates the last node of a polyline. The laser will turn off and jump to the next Jump node after reaching Polyline C. If you delete a Polyline C the last Polyline B will become a Polyline C. When unselected, Polyline C will appear small. When selected, it becomes a larger square with a bold outline.



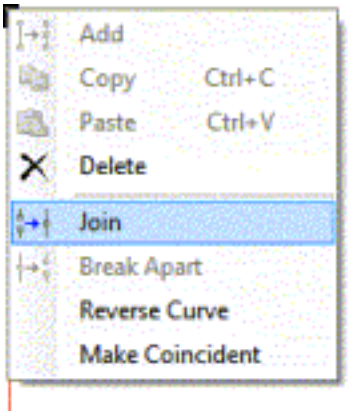


Closing a Path – To close a path it is necessary to have the polyline nodes Jump -> A -> B-> … -> B -> C and have the Jump and Polyline C at the same coordinate. Once the node order has been verified the path can be closed by selecting the Jump and Polyline C nodes, right clicking on one of them, and selecting "Make Coincident". The two will move on top of each other by splitting the difference in distance and the path's Closed Path parameter will change to "Yes". The vector path will no longer be red. To minimize vector path disruption the two vector nodes should be placed as close to each other as possible.

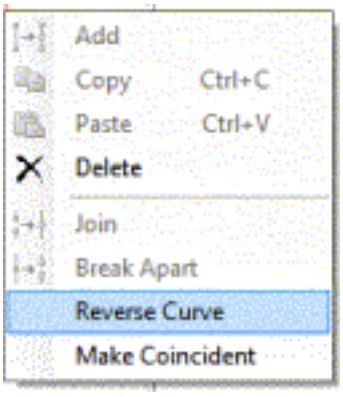




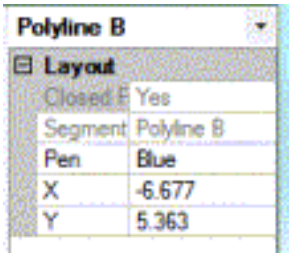
Combining Multiple Polylines into a Single Polyline – Sometimes a polyline will not fill because it is composed of multiple smaller polylines. This occurs whether or not each Jump and Polyline C segment are located correctly because a polyline must follow the rules to fill. Combining multiple polylines is easy. Separate each polyline's Jump and Polyline C node. If the Jump and Polyline C nodes of adjacent polylines are near each other select them, right click on a node, and click "Join". This will combine the polylines and convert nodes at the junction to a Polyline B type.



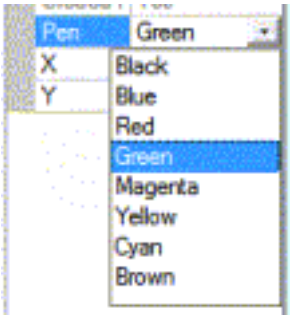
Sometimes the polylines can't be joined because they are "head-to-head" or "tail-to-tail" where the nodes you wish to combine are of the same type, Jump or Polyline C. To join these nodes you can first do "Reverse Curve" to change the direction of marking of one segment and then join to combine the segments. Reverse Curve will change the Jump node to Polyline C, the Polyline C to Jump, and the Polyline B next to the new Jump to a Polyline A node. Reverse Curve can also be used to change the direction of marking of a polyline segments.



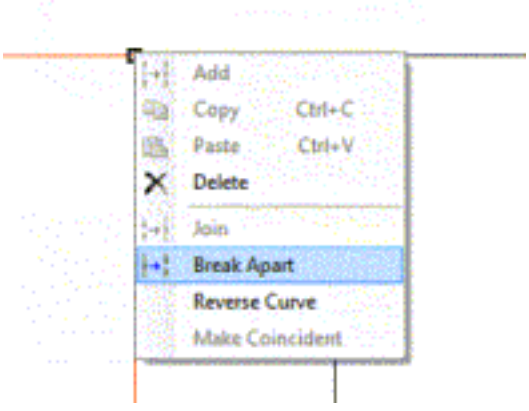
Closed Path – The closed path window indicates "Yes", indicating that the node is the part of a closed polyline, or "No" indicating that it is unclosed. If unclosed and WinLase Hatch Fill is used the unclosed section will either not mark or cause problems with the hatch fill in the rest of the artwork. A selected unclosed path will appear red on the screen.



Selecting a Pen – To select a Pen for a group of vectors use the mouse to select the nodes and then use the Pens pull-down to change the pen for the selected vectors. For a detailed explanation of the "Pen", refer to the "Show Pens" section earlier in this section.



Breaking Apart a Polyline – Polylines can be separated using the "Break Apart" option. If a polyline is broken apart the Polyline B node and adjacent nodes will be converted into Polyline A, Polyline C, and Jump nodes as appropriate and maintaining the direction of travel of the polyline. Rejoining the Jump and Polygon C nodes will combine the polyline again.

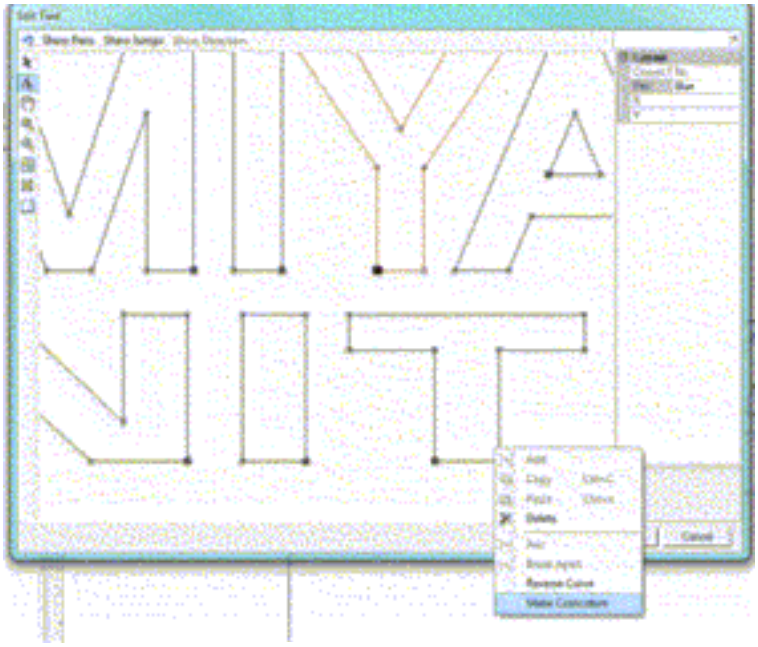


Fixing Artwork that won't Hatch Fill correctly

Fixing a problem graphic requires analyzing each polyline in the graphic and ensuring that they are all closed. Spline vectors, open segments, polylines consisting of multiple polylines end to end, and vectors that are superimposed on each other are common causes of Hatch Fill issues. To fix a graphic's Hatch Fill in WinLase it is necessary to turn Hatch off, make the fixes, and only then turn Hatch Fill back on. If you edit a Hatch Filled graphic, all the fill vectors will be part of the file in the Edit Tool.

A single open polyline can cause all kinds of problems throughout the graphic and not necessarily near where the opening occurs. This graphic has a single problem with the "Y" not having the Polyline C and Jump nodes superimposed correctly.

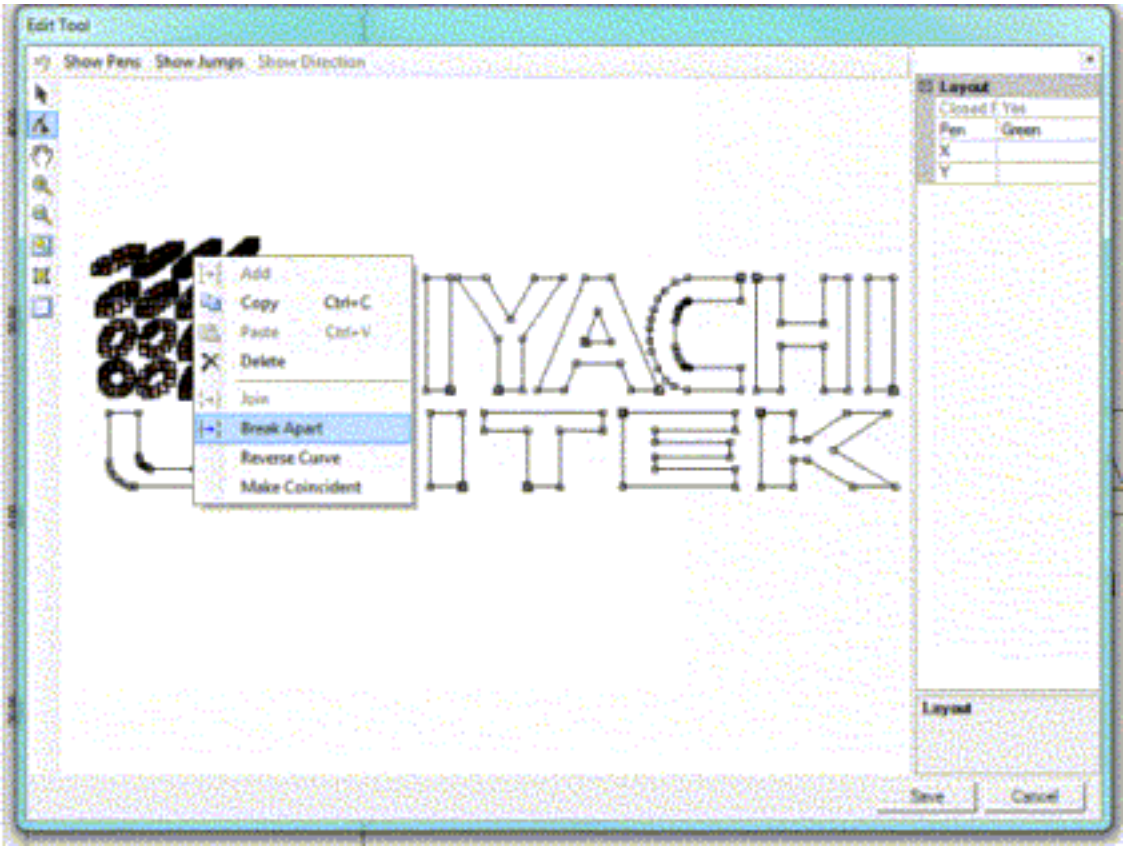
Making the endpoints coincident closes the polylines and allows for a successful fill. Note the red color of the vectors in the Y and the "Closed Path: No" in the Layout information area.



Breaking up Artwork into Multiple WinLase Objects

Taking a single artwork object and making it into multiple objects is a common use for the Edit Tool. One reason this might be desirable is to apply different hatch fill parameters to different parts of an object, to apply different Conditional I/O to different parts of an artwork object, or to change laser parameters without using Pens.

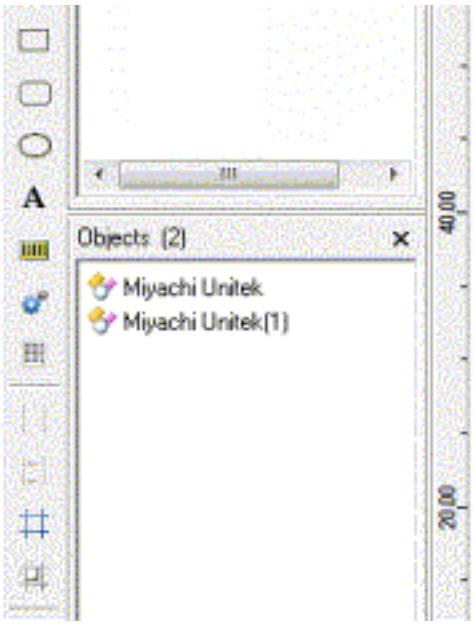
First, open the artwork in the Edit Tool and select it. Using the Edit Vectors tool select the vectors to be broken out into a new object and click “Break Apart”.



The selected section will be separated and can be manipulated separately in the selection screen of the edit tool.

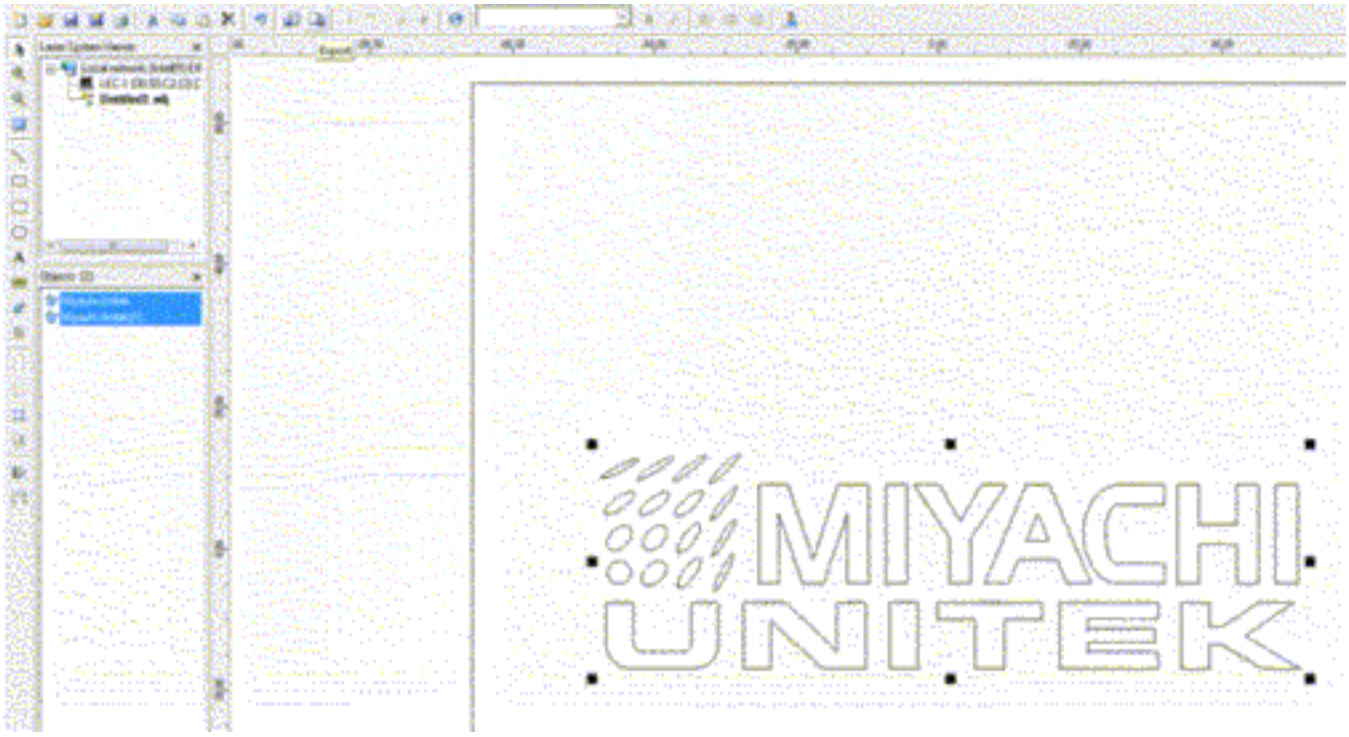
Here the logo is moved slightly:

Clicking Save returns to the WinLase GUI and each component is saved as a separate WinLase object in the object list. In addition, each object is saved as a separate WLO file in the working folder of the PC.



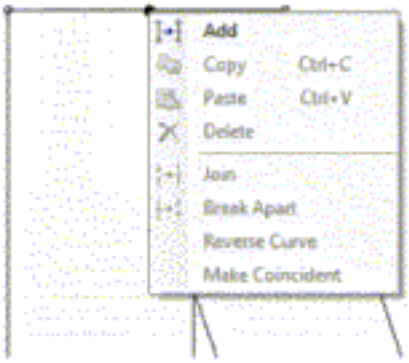
Combining Multiple WinLase Objects into One

Combining multiple WinLase objects is simple. Select both objects at the same time and use WinLase's Export tool to save them as a single WLO or PLT file. The file can then be imported as usual. Once back in WinLase the new single piece of artwork can be edited using the Edit Tool.



Editing Individual Nodes

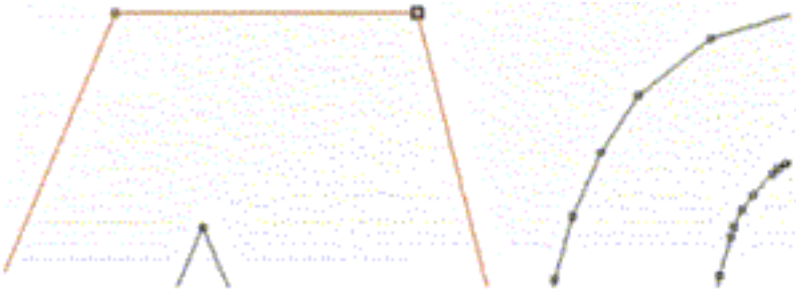
Individual nodes can be edited by selecting and dragging. Nodes can be added by right clicking on a vector line and clicking “Add”.



Nodes can be dragged once added.

If a node is deleted by right clicking and selecting “Delete” the new vector will appear as a straight line between the remaining nodes. If the deleted node is at the end of a spline then the spline segment next to the deleted node will disappear.

Dragging a node will move adjacent vectors.



CHAPTER 4
MAINTENANCE

Section I: Safety Precautions

DANGER

To prevent eye damage when maintaining this equipment, laser protective goggles must be worn at all times (per ANSI Z136.1). Laser goggles with an OD (optical density) of 7+ (at a wavelength of 1060-1150nm) are recommended or as directed by your LSO.

WARNING

- ***Before*** starting any maintenance procedure, read ***all*** of the instructions, including all **CAUTION** and **WARNING** messages.
- ***Before*** starting maintenance work, turn the power to the Marker OFF and disconnect it from input AC power. Wait at least 5 minutes after turning OFF power before starting work.
- Keep the exterior of the Marker clean. If the outside of the Marker is stained, wipe it with a dry or slightly moistened cloth. If badly stained, use a mild detergent or alcohol to clean it. Do ***not*** use paint thinner, acetone, benzene, etc. which can discolor or deform the parts.

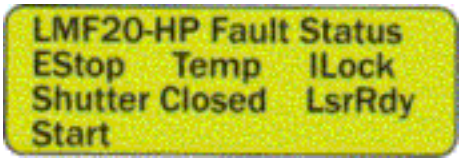
CAUTION

Do ***not*** attempt to remove the fiber at the rear of the marker head from the isolator under any circumstances. Doing so will ***destroy*** the fiber and void the warranty. Amada Miyachi America assumes no liability for such action, the fiber will have to be replaced at the customer's expense.

Section II: Troubleshooting

If the Marker develops any fault conditions, the type of trouble will display in the LCD Display Screen and the Fault Indicator LEDs will flash. Several fault messages may display at the same time as shown on the sample LCD screen below. If you see the LEDs flashing, check the message on the display screen and refer to the chart below for assistance.

NOTE: The shutter will close immediately on any fault, and a power supply fault will occur in most cases. This power supply fault is an induced fault and not the primary fault unless it occurs alone.



To reset from a fault condition, clear the cause of the fault and cycle the key switch or send an I/O signal to the Fault Reset I/O bit as detailed in *Appendix B*.

8-79-P, Q, R, E Models

Error	Number of Flashes	LCD Screen Display	Cause/Corrective Measures
Emergency Stop	3	EStop	Emergency stop circuit is open. Verify the **E-Stop** connector on the rear panel is closed, the E-Stop switch on the front panel is not active and the laser head cover is securely installed.
Startup Fault System Timeout	7	Start	The system has reached the end of its timeout without the laser or control hardware reaching a ready state. Please ensure that no other faults exist and clear by cycling the key switch.
Shutter Fault	2	Shutter	A shutter fault has occurred. Please cycle the key switch to try and recover. If the fault continues please check the remote interlock circuit. Ensure that a start job signal is not being sent through External I/O or Remote API within 100ms of a shutter open event. If the trouble continues, contact Amada Miyachi America.
Laser Ready Fault	4	LsrRdy	A laser module fault has occurred. Contact Amada Miyachi America if the problem cannot be cleared.
Laser Temperature	5	Temp	The laser temperature has exceeded the maximum allowable temperature for laser emission. Turn the machine off and allow the unit to cool down. If the laser temperature does not decrease after a period of time, the air filter may be clogged or airflow might otherwise be obstructed. Check that the ambient temperature is 94°F (35°C) or below for LMF35-HP models or 104°F (40°C) or below for other models. If the trouble continues, contact Amada Miyachi America. The laser module temperature is displayed on the front panel LCD screen for LMF Series "-HP" modules. The module temperature range varies between ambient and ambient +10°C depending on the warmup state of the laser. Laser faults on non-HP models occur at 45°C module temperatures, and 55°C on –HP models.

Error	Number of Flashes	LCD Screen Display	Cause/Corrective Measures
Power Supply Fault	6	PSup	The internal power supplies are in a fault condition. This fault is typically caused by another fault state. Clear any existing faults and try again. If the power supply fault persists and no other faults are active, turn off the machine at the switch on the back of the unit. Wait 3 minutes and restart. If the problem returns contact Amada Miyachi America.
Remote Interlock Fault	8	ILock	The remote interlock was open when the laser was firing or instructed to fire. Close the remote interlock, remove the partially marked part if applicable, clear the fault, and try again.

8-79-B,C,D Models

Error	Number of Flashes	LCD Screen Display	Cause/Corrective Measures
Emergency Stop	3	EStop	Emergency stop circuit is open. Verify the **E-Stop** connector on the rear panel is closed, the E-Stop switch on the front panel is not active and the laser head cover is securely installed.
Startup Fault System Timeout	7	Start	The system has reached the end of its timeout without the laser or control hardware reaching a ready state. Please ensure that no other faults exist and clear by cycling the key switch.
Shutter Fault	2	Shutter	A shutter fault has occurred. Please cycle the key switch to try and recover. If the fault continues please check the remote interlock circuit. Ensure that a start job signal is not being sent through External I/O or Remote API within 100ms of a shutter open event. If the trouble continues, contact Amada Miyachi America.
Master Oscillator Fault	4	MOFault	A laser module fault has occurred. Contact Amada Miyachi America if the problem cannot be cleared.
Laser Temperature	5	Temp	The laser temperature has exceeded the maximum allowable temperature for laser emission. Turn the machine off and allow the unit to cool down. If the laser temperature does not decrease after a period of time, the air filter may be clogged or airflow might otherwise be obstructed. Check that the ambient temperature is 94°F (35°C) or below. If the trouble continues, contact Amada Miyachi America.
Back Reflection	6	BkRefl	High levels of laser back reflection have been detected and the laser fire sequence has been interrupted to protect the laser. Wait 20 seconds, clear the fault, and try again. If the problem continues to occur consider changing process or materials to reduce reflection or work away from the center of the field.
Remote Interlock Fault	8	ILock	The remote interlock was open when the laser was firing or instructed to fire. Close the remote interlock, remove the partially marked part if applicable, clear the fault, and try again.

Section III: Emergency Stop and Interlock Safety Controller Status and Error Indications

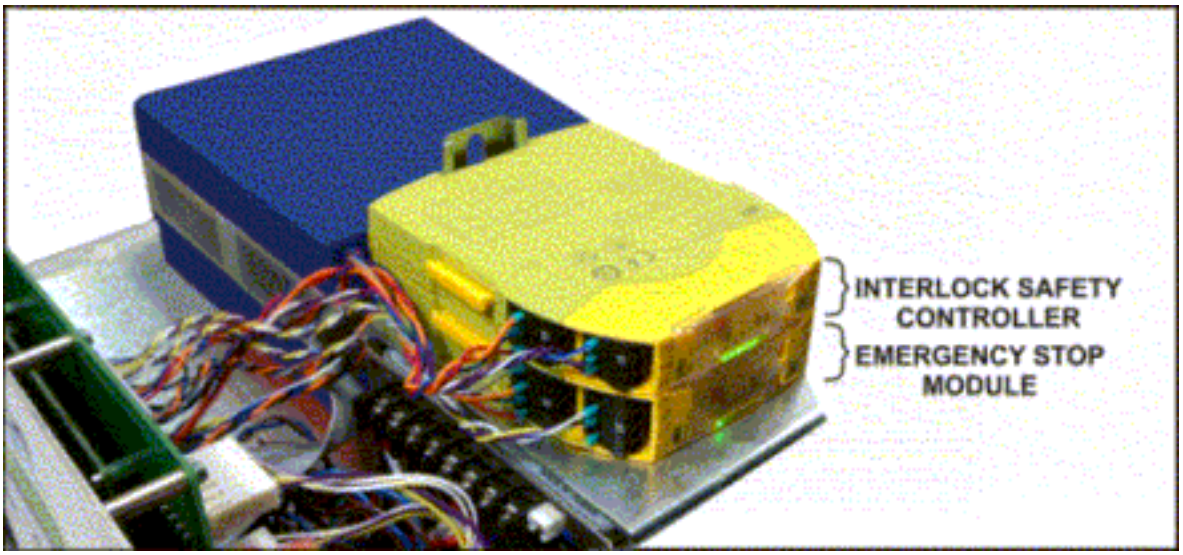
Emergency Stop and Interlock Controller Status and Troubleshooting

In some cases it might be necessary to observe the LED status indicators on the Emergency Stop and Interlock safety controllers. This might be necessary in a situation where it is not possible to reset the interlock or emergency stop circuit and everything externally seems correct. Examples of problems could be from miswiring of external emergency stop or interlock inputs, using a voltage or current source instead of a dry contact on the inputs, a shorted AC contactor, or other electronic failure.

To locate the Emergency Stop and Interlock controllers:

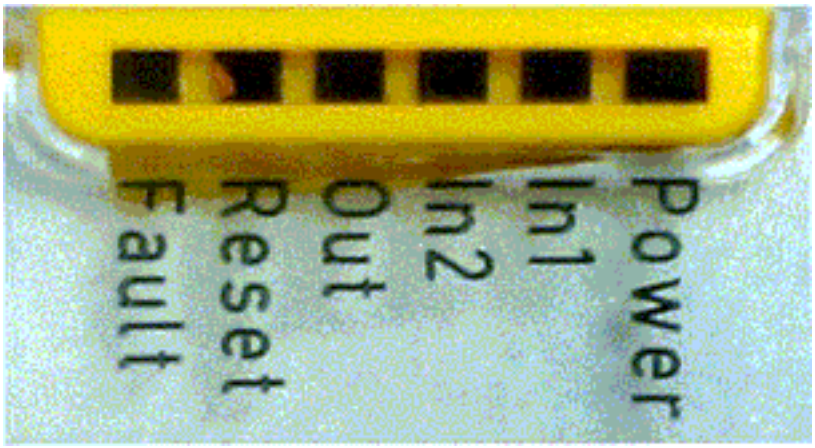
1. Power down the unit.
2. Remove the power cable from the back.
3. Wait 5 minutes.
4. Remove the screws holding the cover of the power supply and remove.

The controller modules are the yellow modules located in the front of the unit behind the LCD screen on top of the power supply mounting bracket. The thinner (top) module is the Interlock safety controller and the thicker (bottom) module is the Emergency Stop module.



Use the following information to understand the LED indicators and diagnose the problem.

There are several status LEDs visible on the emergency stop and interlock controller status monitoring windows. This section will detail useful combinations to assist troubleshooting. Status and error messages have the same function in both emergency stop and interlock circuits.



Status indicators and errors may occur independently. In the case of an error display the “Fault” LED will light or flash (exception: Supply voltage too low). An LED that is also flashing indicates the potential cause of the error. A LED that is lit and static indicates a normal operating condition. Several status indicators and error indicators may occur simultaneously.

Status Indicators

Power (solid)

Supply Voltage is Present

In1 (solid)

Input Channel 1 is currently closed and no faults are detected. The safety circuit pulse pattern transmitted through the In1 channel has returned to the safety controller and no faults have occurred.

In2 (solid)

Input Channel 2 is currently closed and no faults are detected. The safety circuit pulse pattern transmitted through the In2 channel has returned to the safety controller and no faults have occurred.

Out (solid)

Safety contacts are closed and the contactor output is active. This output is required for normal operation.

Reset (solid)

The reset signal has been received from the rear panel reset dry contact or front panel reset button. All contactors must be open and un-welded for this to be detected.

Error Indicators and Suggested Resolution

Contact Malfunctions

If the monitored AC contactor or safety controller contacts have welded together you will not be able to reactivate the circuit. Replace the necessary components.

All LEDs off

Short across contacts to ground or unit switched off. Fix any shorts and switch off supply voltage for 1 minute. Verify the fuse block at the marker AC Input to verify correct input power.

Fault (solid)
Others (off)

Safety controller plug terminator not connected. This situation not applicable to the marker. Contact Amada Miyachi America if this error occurs.

Fault (flashing)
Others (off)

Internal error, safety controller defective or damaged. Verify no miswires in user wiring and replace safety controller. The most common cause is improper voltage or current applied to dry contact inputs via the interlock, reset, or emergency stop headers. Use dry contact closures only.

Power (flashing)

Internal error in marker power supply. Contact Amada Miyachi America for assistance.

In1, In2 (flashing alternately)
Fault (solid)

Short detected between channel 1 and channel 2. Shut down marker power, rectify short across contacts, and try again.

In 1 (flashing)
Fault (solid)

Open circuit detected in channel 1 or input circuits not closed simultaneously. An intermittent connection in channel 1 is also possible. To resolve, open both input circuits and close simultaneously.

In 2 (flashing)
Fault (solid)

Open circuit detected in channel 2 or input circuits not closed simultaneously. An intermittent connection in channel 2 is also possible. To resolve, open both input circuits and close simultaneously.

Reset (flashing)
Fault (solid)

Safety controller mode selection rotary switch position is not valid or rotary switch was adjusted during operation. This fault is possible due to incorrect configuration of replacement parts. Remove power from the marker, set the safety controller mode switch correctly and reapply power.

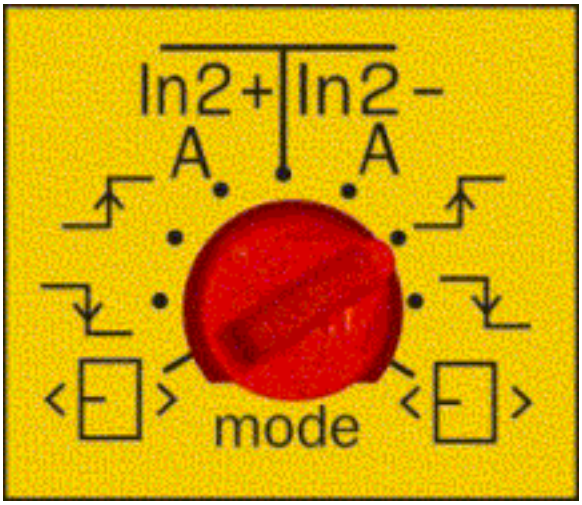
Power (solid)
In1 (solid)
In2 (solid)
Out (solid)
Reset (solid)
Fault (solid)

Safety controller mode selection rotary switch is in the vertical position (not valid). This fault is possible due to incorrect configuration of replacement parts. Remove power from the marker, set the safety controller mode switch and reapply power.

The safety controllers are modular devices that can be replaced if necessary and must be replaced after 10 million cycles. Each controller has 4 keyed and labeled I/O plugs that remain on the wiring harness. Do not use a screwdriver to remove individual wires while replacing a safety controller. Lift the access cover to set the configuration dial using a small screwdriver.

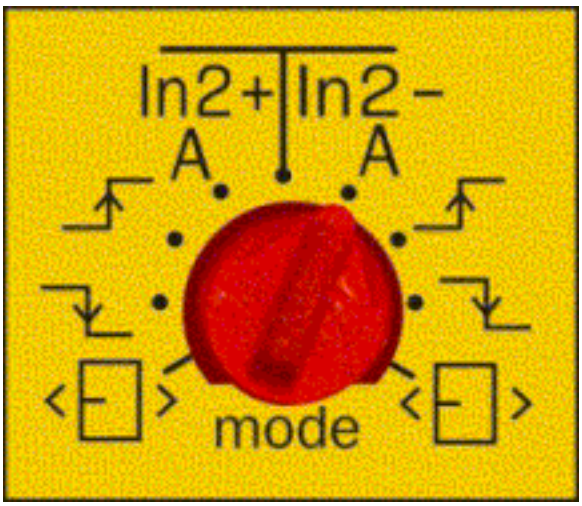
Emergency Stop Controller Configuration Dial Setting

Set the configuration dial to match the one below. The correct configuration is “In2- Rising Edge”. Incorrect configuration can cause the emergency stop circuit to malfunction or not provide adequate safety protection.



Interlock Controller Configuration Dial Setting

Set the configuration dial to match the one below. The correct configuration is “In2- A” for automatic reset. Incorrect configuration can cause the interlock circuit to malfunction or not provide adequate safety protection.



Section IV: Lens Installation and Cover Glass Cleaning Instructions

Each *f*-theta lens is equipped with an optically-coated protective glass. When marking materials over a period of time, many of the airborne particles produced during the marking process can dirty or fog the protective glass. ***It is important to keep the protective glass clean.*** If the protective glass is dirty and continually used, the contaminants may permanently damage the glass surface. When cleaning the surface, use only lens cleaning paper. A scratched glass surface will cause undesirable marking results.

CAUTION

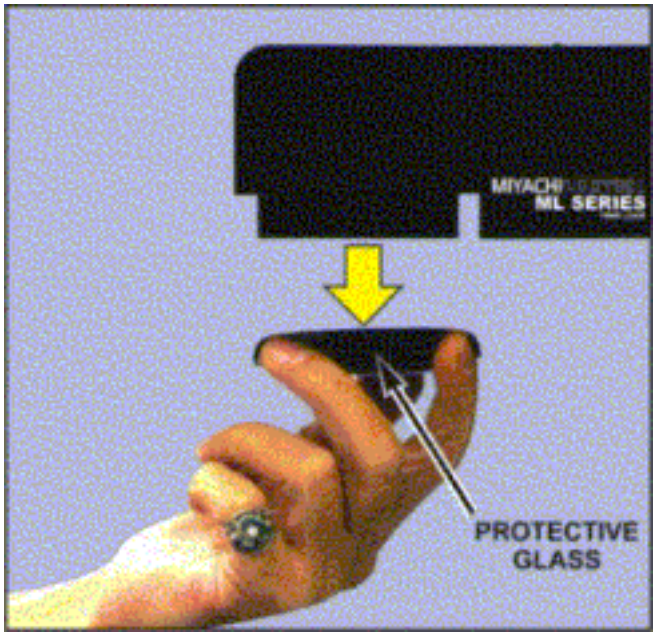
To prevent dust contamination, ***always*** wear powder free latex gloves before performing any steps involving optics. Perform the following steps in a location free of dust or other airborne contaminants.

Required Items:

- Lens Cleaning Paper
- Acetone
- Air Blower
- Powder-free Vinyl Gloves or Finger Cots

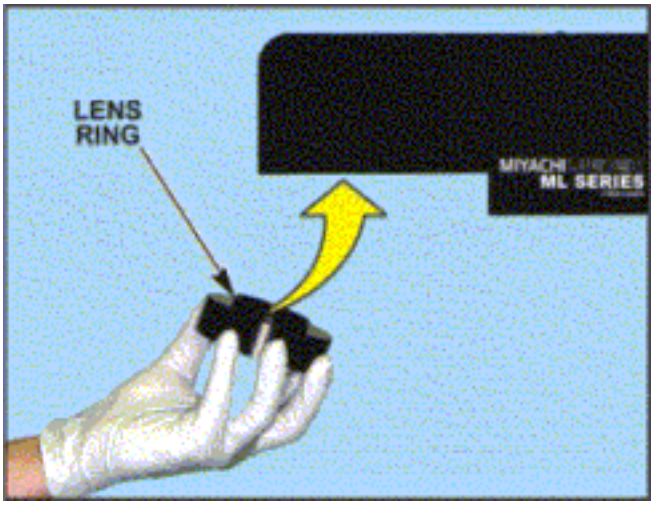
1. Turn the power OFF.
2. Turn the protective glass holder CCW (counter-clockwise) to remove it. Take care ***not*** to drop it.

   NOTE: ***Before*** you clean the protective glass, put on a pair of powder-free vinyl gloves or finger cots.

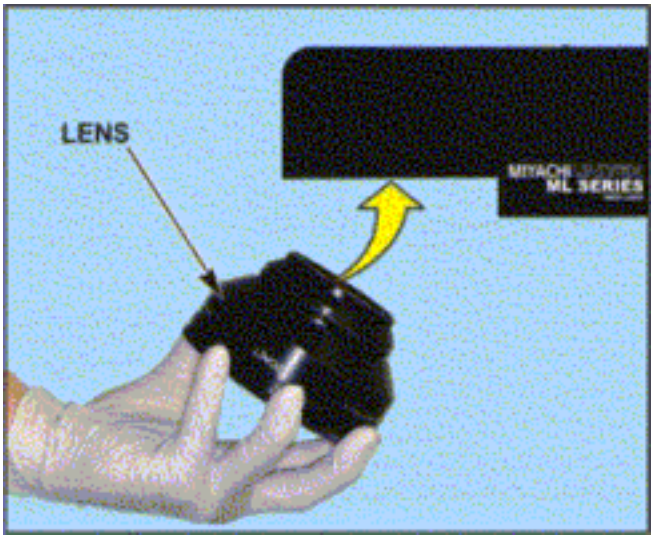


3. If necessary install the lens ring by screwing it into the laser head.

   NOTE: Different focal length lenses require different lens rings so it is important that the correct lens ring is selected.



4. Install the lens by screwing it into the lens ring.

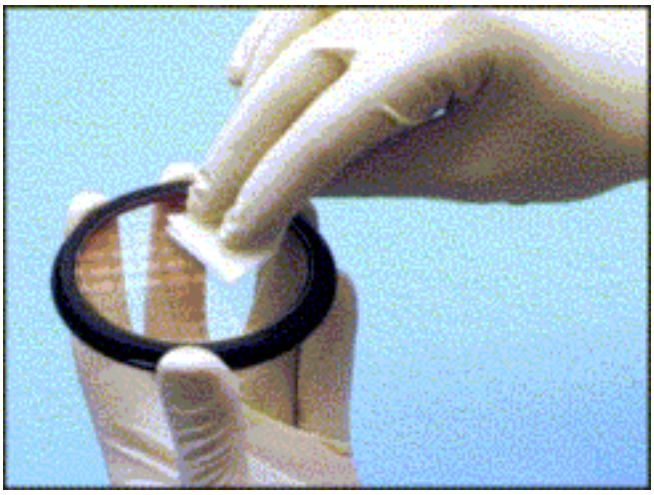


5. Clean the cover glass with lens paper and appropriate solvents.

   When cleaning, ***draw a spiral pattern from the center of the glass as shown***.

   NOTE: If you cannot get the protective glass clean after several attempts, replace the protective glass with a new unit.

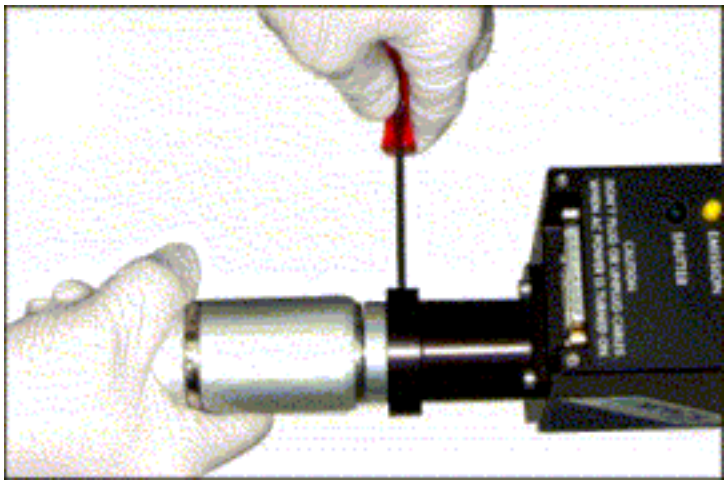
6. Install the protective glass back onto the Marker head.



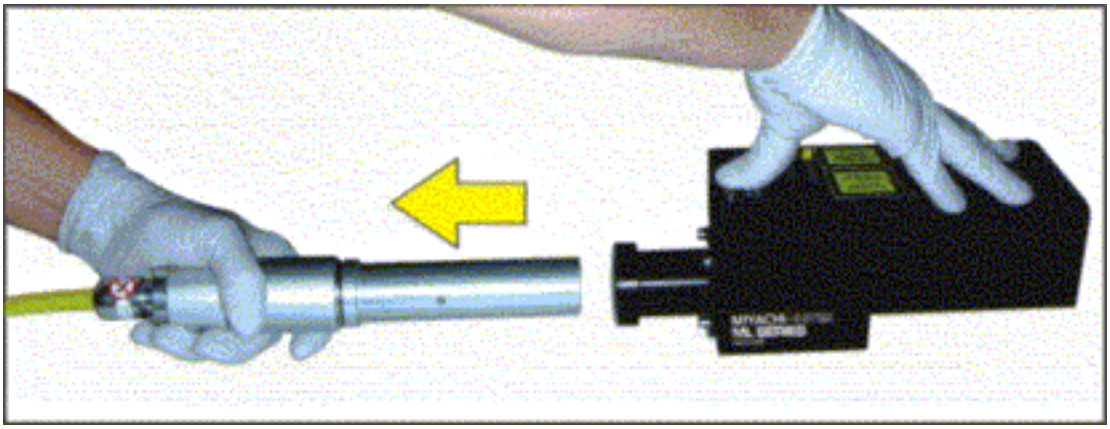
Section V: Remove / Install the Collimator

Removing the Collimator

1. Loosen the clamp screw to allow for collimator removal

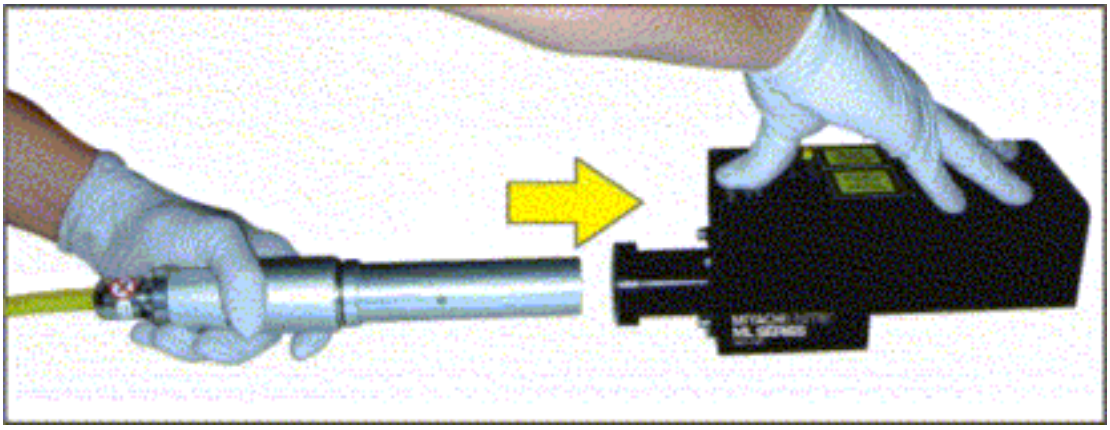


2. Remove the collimator/isolator assembly from the head. Slight force will be required to overcome friction with the O-rings.

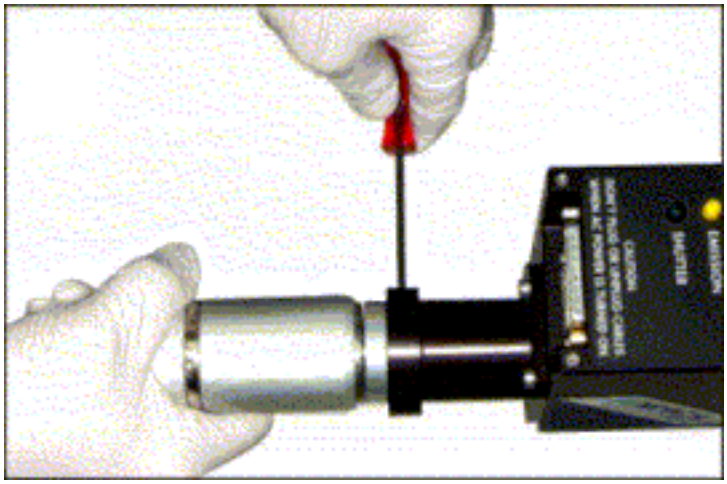


Collimator Installation

1. Insert the collimator/isolator assembly as far as possible until the flange of the collimator is adjacent to the clamp. Some force will be required due to an o-ring that seals the collimator/isolator assembly to the head. If force seems excessive stop, check the O-ring and clamp screw to make sure the clamp is not tightened, and try again.



2. If applicable rotate the collimator / isolator assembly to align the arrow on the collimator/isolator assembly with the scribe mark on the clamp.
3. Tighten the clamp fastener.



Section VI: Replace the Air Filter

NOTE: The air filters on the Marker need to be cleaned regularly to reduce the risk of overheating caused by restricted airflow into the device. Please change the filters every 1-6 months depending on the operating environment.

1. Verify that the Marker has been turned OFF.

2. Loosen the four captive screws on the **COOLING FAN COVER** and remove the cover.

3. Slide both black and blue layers of the **AIR FILTER** out of the opening.
4. Put a new or cleaned **AIR FILTER** into the opening. Replace both the black and blue filters in the orientation shown in the picture
5. Put the **COOLING FAN COVER** back on the front panel and re-install and tighten the screws.

Section VII: Firmware Update

WARNING

When updating the marker firmware, ***all files stored locally on the marker will be lost.*** Backup all job files that have been stored in the marker's flash memory.

From time to time, Lanmark Controls, Inc. will release an updated version of the firmware that is resident on the Controller Card inside the Laser Marker. This update may be in the form of a single file, or a web link. The Firmware update procedure needs to be completed in a specific way. An incorrect update will render the Controller Card inoperable and will need to be sent back to the factory for repair. Use extreme caution when updating the firmware in your Laser Marker.

Please contact Amada Miyachi America for the latest update procedure. See **CONTACT US** in the front of this guide to get in touch with us by e-mail, telephone, or regular mail. In order to determine which Firmware Update Procedure you'll need, please determine the model number of your Marker, then use the table below to determine the correct procedure to use:

LMF Marker	LMWS Marker	Correct Firmware	Procedure
8-79-xLx-xxx	8-791-xLx-xxx-xxx	2.x.x.x	MFG-364
8-79-xBx-xxx	8-791-xBx-xxx-xxx	6.x.x.x	
8-79-xCx-xxx	8-791-xCx-xxx-xxx	7.x.x.x	MFG-366
8-79-xDx-xxx	8-791-xDx-xxx-xxx		
8-79-xEx-xxx	8-791-xEx-xxx-xxx		

Section VIII: Repair Service

If you have problems with your Laser Marker that you cannot resolve, please contact Amada Miyachi America; see **CONTACT US** in the front of this guide to get in touch with us by e-mail, telephone, or regular mail.

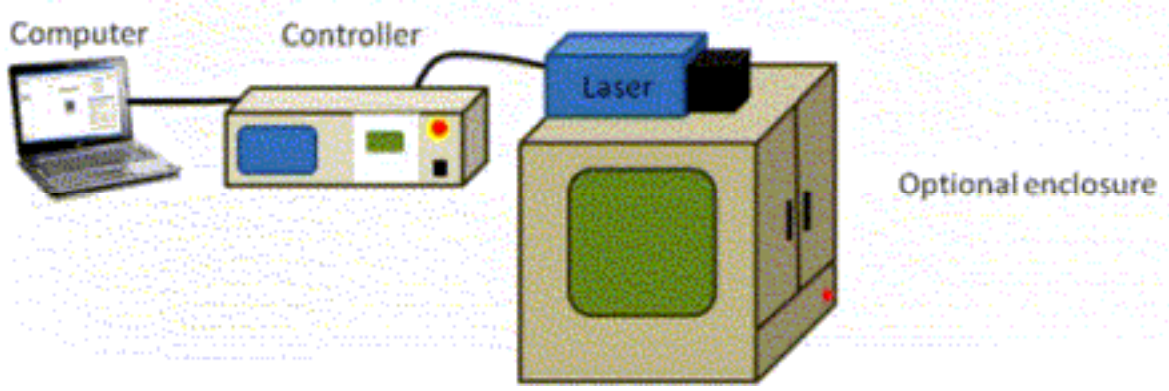
CHAPTER 5
INTEGRATION AND REMOTE INTERFACE

Section I: Understanding the Two Types of Integration

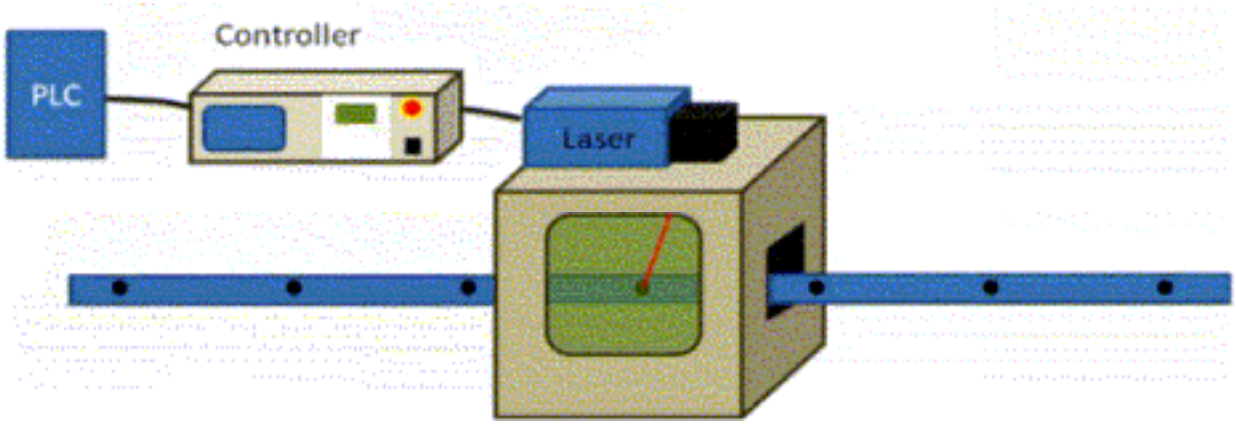
Streaming Vs. Local Mode (Stand-alone)

The first choice an integrator must make when choosing a mode of implementation for a LMF Fiber Laser Marker is to select whether or not the machine will be used in a PC-centered process or automation-centered process.

- In a PC centered process the PC is responsible for controlling the laser and sends the laser vector data at runtime to the laser for execution. This is called “Streaming Mode”



- In a laser centered process the laser marker uses mark information stored internally to execute jobs under the control of a PLC, external machine controller, or even a PC running custom laser control software. This is called “Stand-alone Mode” since the laser marker is the center of the process and stands alone without a required PC once the jobs are stored to the laser. Stand-alone mode is preferred if supported by the application requirements.



Streaming Mode Summary of Options - See *Section III* of This Chapter

- The *WinLase LAN*™ GUI (Graphical User Interface) streams data at run time from the PC to the laser marker when the operator uses the "Run" or "Quickmark" options. I/O for basic automation is supported.
- **COM Server** – A Streaming Mode variant that allows the user to program their own GUI to substitute for *WinLase* using a DLL library. Sometimes used for custom applications or processes requiring a customized user interface via PC. See details in the COM server manual installed in *C:\marker\documentation* provided via the *WinLase* install package. This has the highest initial requirements since a programmer must integrate laser DLL libraries to control the machine. This implementation is not recommended in most cases as it is easier and better to write a custom application that uses the Stand-alone mode interface.
- **Streaming Mode** HostLAN Interface –The Host interface is another way to interface with *WinLase* streaming mode over TCP/IP or RS-232. It uses a command set similar to the Remote Command API and requires a PC with *WinLase* running to interface to the external controller. The PC running *WinLase* software must be present at all times with *WinLase* running in the background. This interface can be used in situations where the Remote Command API may not support a specific feature. In all other situations the Remote Command API is preferable.

Stand-alone Mode Summary of Options - See *Section IV* of this chapter

For all Stand-alone implementations the jobs are first created then stored in the laser marker storage. The external interface calls jobs, manipulates data, and executes processes under the direction of control equipment or custom PC software.

- **Remote Command API** (Application Programming Interface), for interaction with a PC or PLC through TCP/IP (Client/Server) or RS-232. In API Mode the data can be stored locally on the laser's Flash memory and/or USB storage, or loaded remotely over the network. A PC running *WinLase* software is required only for setup but not for operation. When possible this is the preferred mode of operation due to speed and efficiency of laser marking processes. See *Section III* of this chapter.
- **I/O Job Select** Mode – up to 255 jobs can be stored on the laser marker and executed using simple I/O. It is possible to combine this mode with API commands for advanced data handling while still selecting jobs via I/O. This mode has the same speed and performance benefits as the Remote API.

It is the responsibility of the system integrator to choose the correct mode for the desired process. To ease in this choice, a Mode Selection Flowchart is included in *Section II* of this chapter. Please use this to determine which mode is best for your implementation. Consult Amada Miyachi America if questions arise.

Be aware that, due to the architecture differences between the modes, some features may be available in one mode but not another. Please consult the Feature Compatibility chart in this section.

Modes requiring data stored on the laser marker must keep individual job sizes under 10MB. 10MB of onboard flash storage is available and USB storage up to 2GB can be used to increase capacity. Large jobs over 10MB in size must be executed in streaming mode.

Section II: Selecting the Best Interface Mode For Your Application

How does one select the best mode for an application?

Ask These Questions:

1. Is there data that changes from part to part?
2. Where does that data come from, and who puts it in?
3. How does the operator interface with and control the laser? Will standard *WinLase* allow for the desired experience? Is custom software required?
4. Are there any specific features in the desired mark that have mode compatibility considerations? (e.g., mark on the fly, marker motion, etc).

   NOTE: See the compatibility matrix in this section to verify that all features needed work in the chosen mode.

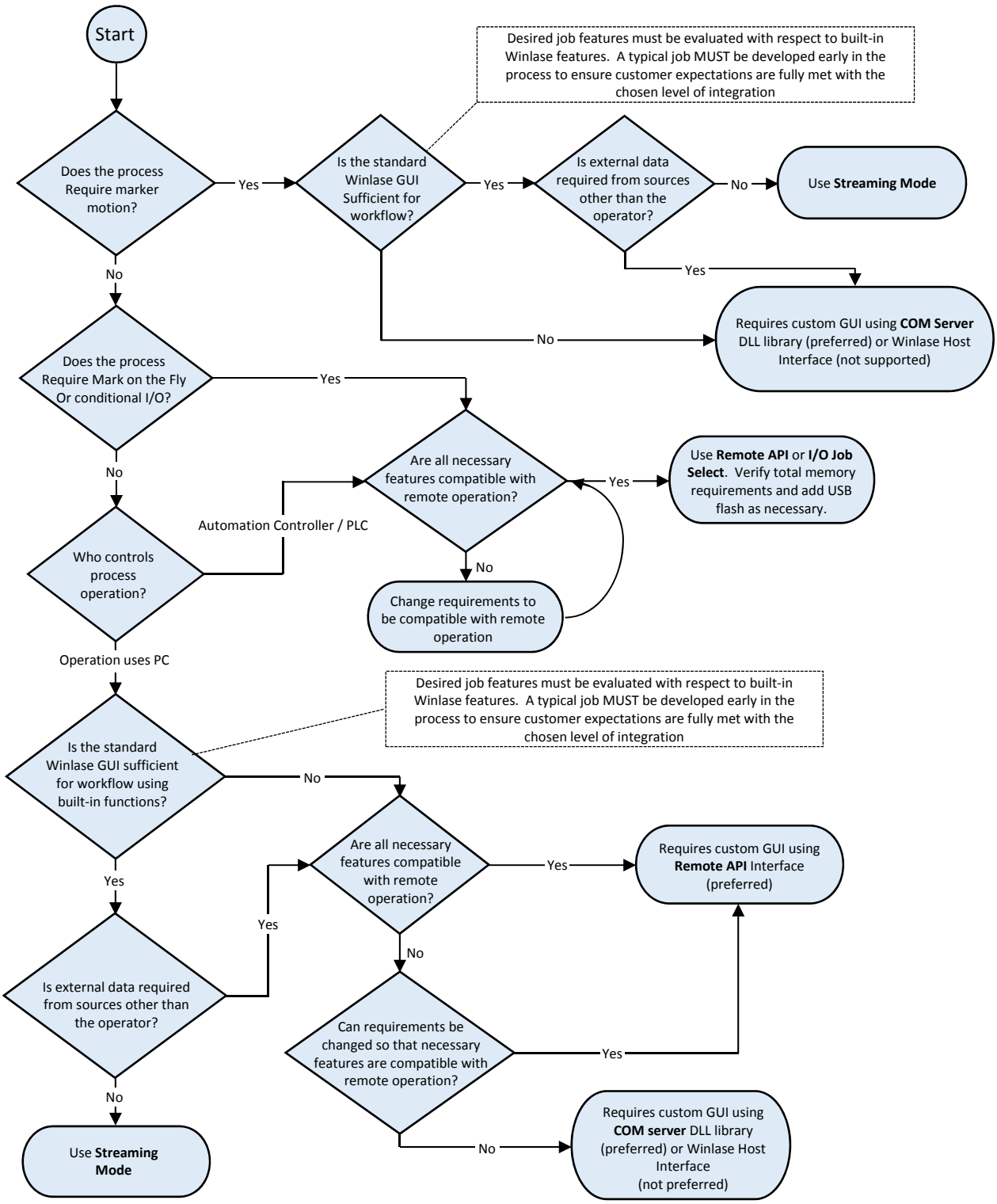
To Make a Selection

- Answer the questions above, and follow the "Integration Mode" flowchart in this section.
- For simple systems (laser and enclosure) the streaming mode is preferred. This mode supports barcode scanner and operator input among other methods.
- For automated systems or systems accessing databases, files, etc. the Stand-alone mode is preferred. PLC controlled assembly lines require Stand-alone mode.
- Specific customer interface/process requirements require a custom program with an interface that uses Stand-alone mode.
- Some features (like Mark on the Fly) make the decision for you. Always verify features against the compatibility chart included in this section.

Once the decision between streaming and Stand-alone mode has been made there are several options on how to accomplish machine integration. Note that it is often possible to combine multiple interface modes to achieve the desired results.

LMF Series Fiber Laser Marker
Integration Mode Selection Guide

Note: Refer to Feature Compatibility Matrix to verify Compatibility of feature with chose mode



Important Feature Compatibility Issues between Streaming and Local Modes Firmware Versions 2.x and 6.x – Local Mode (Stand-Alone)

Feature	Streaming Mode	Local Mode Firmware Versions 2.x (8-79-xLx-xxx)	Local Mode Firmware Versions 6.x (8-79-xBx-xxx)
Mark on the fly	No	Yes	Yes
Multi-axis motion	Yes	No	Yes
I/O Job select	No	Yes	Yes
General I/O	Yes	Yes	Yes
Conditional I/O at mark time	No	Yes	Yes
True type font	Yes	Static fields only; Dynamic fields with vector TTFs using “Font Creator” function (same end results)	Yes
Touch-Screen / GUI control	Yes	No	No
Custom GUI using COM Server	Yes	No	No
Customer GUI using API	No	Yes	Yes
Network Job Load	Yes	No	Yes

Important Feature Compatibility Issues between Streaming and Local Modes Firmware Versions 7.x – Local Mode (Stand Alone)

Feature	Streaming Mode	Local Mode Firmware Versions 7.x (8-79-xCx-xxx)	Local Mode Firmware Versions 7.x (8-79-xDx-xxx)
Mark on the fly	No	Yes	No
Multi-axis motion	Yes	Yes	Yes
I/O Job select	No	Yes	Yes
General I/O	Yes	Yes	Yes
Conditional I/O at mark time	No	Yes	Yes
True type font	Yes	Yes	Yes
Touch-Screen / GUI control	Yes	No	No
Custom GUI using COM Server	Yes	No	No
Customer GUI using API	No	Yes	Yes
Network Job Load	Yes	Yes	Yes

Note: The Firmware Version 7.x (8-79-xEx-xxx) does not operate in Local (Stand-Alone) Mode

Control Mode-Based Compatibility for Data Changed at Runtime

Feature	Streaming Mode (except COM Server)	Local Mode (API) Firmware Versions 2.x (8-79-xLx-xxx)	Local Mode (API) Firmware Versions 6.x & 7.x[1]
PC required for Operation?	Yes	No	No
Vector Fonts	Yes	Yes	Yes
True Type Fonts (.TTF)	Yes	Static (convert to vector for variable)	Yes
Data Matrix	Yes	Yes	Yes
Code 128, Code 39, Code 93, 2 of 5	Yes	Yes	Yes
QR Code	Yes	No	Yes
Other Barcodes	Yes	No	No
Object Transforms at Runtime	No	Yes	Yes
“Get String From Memory Buffer”	No	Yes (via API buffer)	Yes (via API buffer)
“AutoDate”	Yes	Yes	Yes
“Serialize with current start value”	Yes	Yes	Yes
“Serialize with user-supplied start value”	Yes	No	No
“Custom String”	Yes	Yes	Yes
Strings “Controlled by Remote API”	No	Yes	Yes
All Other String Rules	Yes	No	No
Dynamic Text File	Yes	Yes	Yes
Static Data/Barcode/Graphic/Text	Yes	Yes	Yes

Note 1. Versions 6.x and 7.x include models: 8-79-xBx-xxx, 8-79-xCx-xxx, 8-79-xDx-xxx and 8-79-xEx-xxx

Section III: Streaming Mode and the *WinLase* LAN GUI

The *WinLase LAN* Software includes the following:

- *WinLase* Graphical User Interface
- Lanmark Controls Inc. COM server object interface.
- Full documentation on the features of the included software tools. See *C:\marker\documentation*, created with the *WinLase* package installation.

GUI (Graphical User Interface) Features

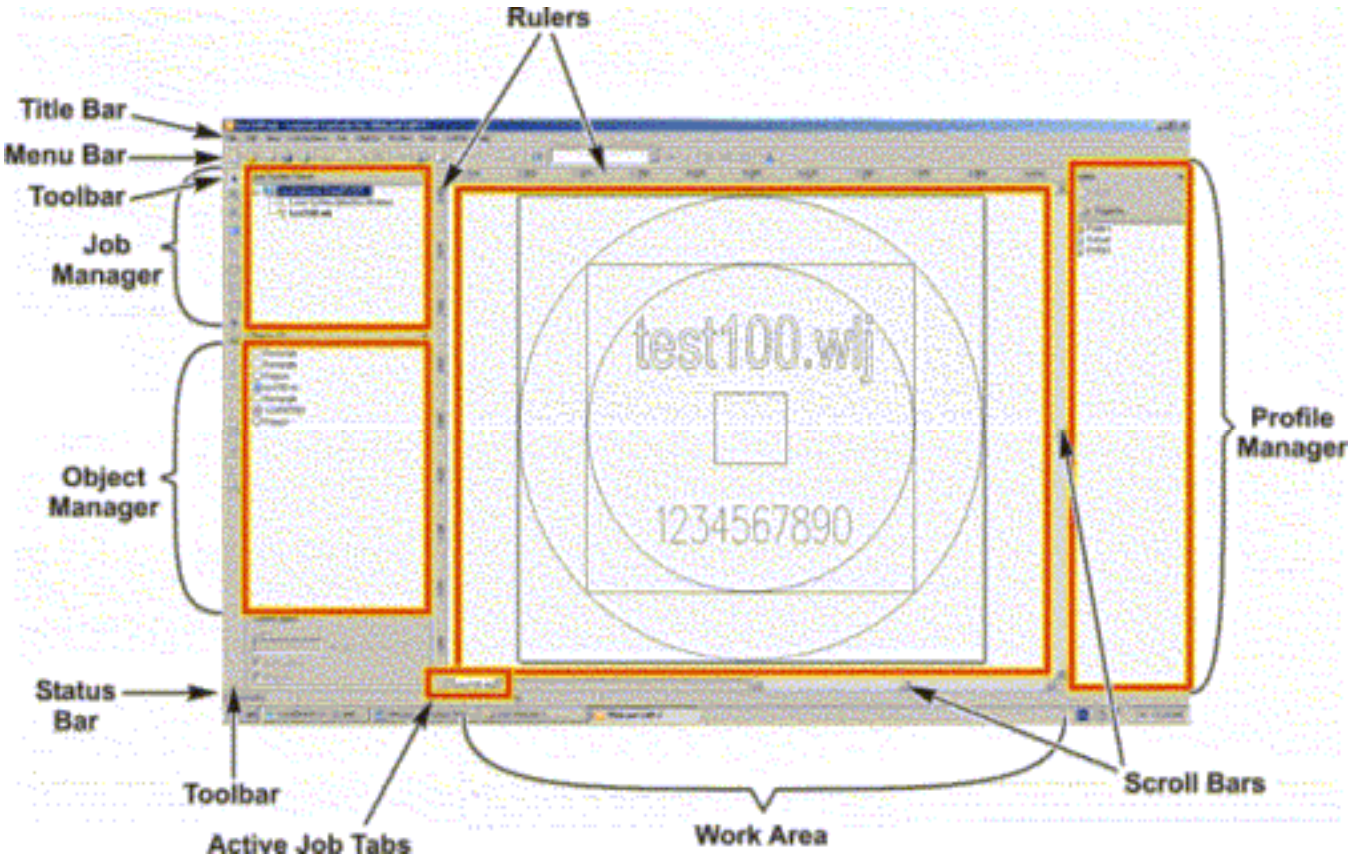
WinLase elements include**:**

- *Line-art graphics: CAD, line-drawings, logos.*
- *Shaded graphics: photos, halftones & grayscale artwork.*
- *TrueType fonts, filled or outline-only.*
- *Single point or drill object arrays.*
- *AutoDate, TextMerge, Serialization, and Barcode.*
- *Automation: I/O control, 4-axis motor control, time delays, and custom operator messages.*

WinLase facilitates the creation, editing, control, execution, and automation of all laser-marking tasks. The *WinLase*™ Software Suite includes the following features**:**

- Password-protected security lockout -- operators can be limited to only selected and running Jobs.
- Multiple open Jobs -- quickly switch between marking tasks with the click of a mouse.
- Background template -- place an image of the parts tooling in the background to aid in mark placement.
- Full support for lasers with visible pointers for real time positioning of the mark.
- HPGL (*.plt), WMF (*.wmf) EMF (*.emf), DXF (*.dxf), EPS (*.eps), JPEG (*.jpg), GIF (*.gif), PCX (*.pcx), Adobe Illustrator (*.AI), Corel Draw (*.CDR) and *Windows* Bitmap (*.bmp) graphic filters.
- Internal capability to generate linear and radial text, barcodes, AutoDate™, serialization, and hole-drilling.
- Complete TrueType font support -- mark any TrueType font installed on the system.
- Scale, move, rotate, group, or reverse any object on the screen.
- Precise numerical control of laser-operation parameters.
- Programmable alerts, warning, and run-time operator input of job numbers, batch numbers, etc.
- Built-in 4-axis motor control -- use rotary tables, linear motion, and/or X-Y tables.
- Text marking on cylindrical parts using an optional rotary indexer.

WinLase contains all of the elements of a multi-element **Job Editor**, automation sequencing tool (simplified ladder logic), and password-protected Operator's Interface. Most procedures can be efficiently served entirely from within the program.



COM Server

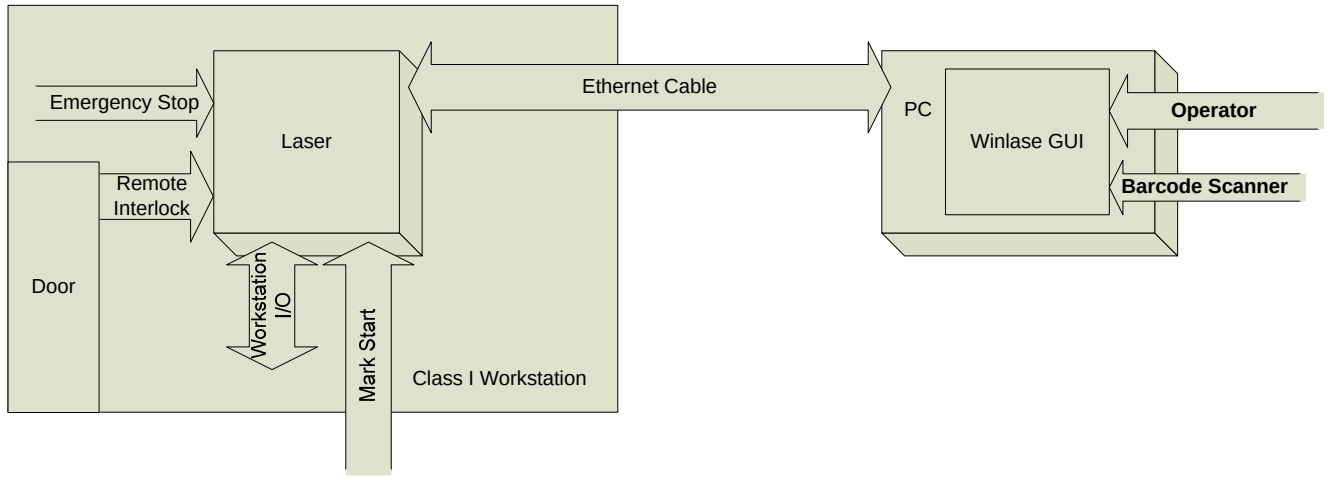
WinLase exposes a COM (Computer Object Module) Automation server, which offers external programs the ability to communicate with and control *WinLase*. For detailed information on the COM Automation server interface commands please refer to the documentation installed in *C:\marker\documentation* by the *WinLase* install package.

Please refer to the *WinLase Reference Manual* for complete details on using the *WinLase* software package.

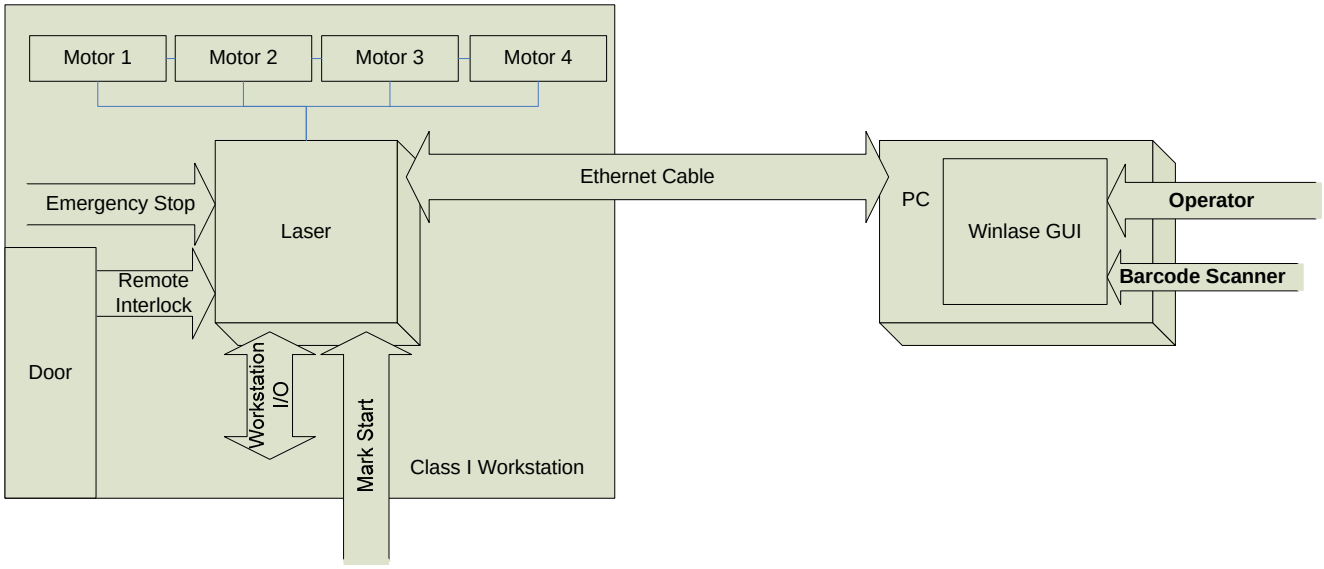
Block Diagrams

Typical Streaming Mode Installations

Basic Semiautomatic Workstation, Streaming Mode, no marker motion



Basic Semiautomatic Workstation, Streaming Mode, marker motion



Integration Notes: Semiautomatic Workstation Operating In Streaming Mode

This style workstation is used for a process flow where an operator loads/unloads part(s) into a laser safe workstation and initiates the process start. Once the process has been concluded the doors will open and the operator will remove the part(s), insert the next batch, and continue.

- The operator loads the program using the *WinLase* GUI and selects the appropriate program. Programs should be configured to watch for the cycle start input.
- The operator begins the mark sequence by clicking "Run Process" in *WinLase*, after which *WinLase* will look for the Cycle Start input.
- Typically a Cycle Start button is used to begin the marking process so the operator does not need to use the PC between marks.
- Any necessary information will be entered by the operator in response to prompts on the PC monitor using the keyboard or barcode reader.
- Automated data input difficult – see Host or API modes for more information.
- All functions must be compatible with streaming mode. See *WinLase* Mode feature compatibility chart.
- Class I enclosure interlocks and emergency stop must be wired to laser. Interlock monitoring in laser should be enabled.
- Streaming mode includes network and data streaming delays that can increase average process time up to 300ms.
- Compatible with up to 4 axes of marker motion.

Section IV: Using the Remote Command API to Control the Laser Marker in Stand-alone Mode

Remote Command API

The LEC embedded control card was designed to be a powerful Stand-alone controller with the ability to accept commands and return responses. The Remote Command API provides extended functionality to load jobs, manipulate marking objects, change administration settings, and many other functions.

There are two methods available for interfacing with the Remote Command API while in Local/Stand-alone mode:

- Message based TCP/IP socket connection
- Message based RS-232 connection

All commands are ASCII based and follow the simple command/response handshake. Each command has an ASCII code that is used to assert the command. For example, **TakeHostControl** uses the ASCII code "**2**". To call **TakeHostControl** the user would send a "2" followed by carriage return/line feed and wait for the response of "**0**", or **Command Success**.

All interfaces are active simultaneously for interacting with the Remote Command API.

All interfaces support making calls to get parameters. Some commands, however require the client to "Take Control" of the LEC Host device. When a client has control, the client can send execution commands as well as commands to set parameters.

It is also common for one client to send certain commands (ex, populate serial number data) that do not require host control while a different client is in control (ex, PLC in I/O Job Selection mode)

Using the API

The LEC Remote Command API uses a message based communication protocol. The client (your program / PLC) and the Host (the LEC) must cooperate by sending messages back and forth in an alternating fashion. Specifically, after a command is sent by the client, the client ***must*** wait for a response from the Host. That response indicates the success (or failure) of the current command. It is illegal to send a new command to the Host before the previous command has been acknowledged with a response, and ***will*** result in undefined behavior.

Messages sent to the Host are text strings, and must end with a line feed. Messages received from the Host are text strings and end in a line feed. For all commands except **SetObjectUTF8String**, character data must be sent using either 7-bit Encoding (ASCII 0 - 127) or 8-bit Encoding (ASCII 0 - 255). To send extended character data when setting the string value of test or barcode objects, encode the character data to send using UTF-8 Encoding, and use the **SetObjectUTF8String** command.

The **Remote Command API** provides a rich set of commands for communication and control of an LEC. The API allows you to get and set system parameters, as well as perform actions with locally stored job files, and to control the behavior of individual objects within job files.

If you are loading and controlling the execution of locally stored jobs, use the **TakeHostControl** command to gain exclusive access to the server. Use the **GetFlashJobFileList** or **GetUSBJobFileList** commands to discover the locally stored job files.

Use the **LoadJobFromFlash** or **LoadJobFromUSB** command to load a job into memory. To select a job previously loaded into memory for execution, use the **MakeJobActive** command. An active job can be executed by using the **ExecuteJobOnce** or **ExecuteJobContinuous** commands. When you are finished sending and receiving commands, use the **Abort** command and then the **ReleaseHostControl** command to allow other hosts exclusive access to the device.

To read the status of server parameters, use any of the **Get** commands. Most of these commands do not require the client to have exclusive access to the server (Host).

To set server parameters, use the **TakeHostControl** command to gain exclusive access to the server. Use any of the **Set** commands to make changes to server parameters. When you are finished setting parameters, use the **ReleaseHostControl** command to allow other hosts access to the API. If any IP settings have been changed, these settings will not take effect until the board goes through a power cycle, or you call **HardwareReset.**

Note: Depending on the LEC Firmware version, some API Commands may not be supported. Please refer to Appendix D for a list of supported API Commands based on Firmware version.

8-79-xLx-xxx - Firmware version 2.x

8-79-xBx-xxx - Firmware version 6.x

8-79-xCx-xxx - Firmware version 7.x

8-79-xDx-xxx - Firmware version 7.x

8-79-xEx-xxx - Firmware version 7.x

Sample API Process Outline with Commands

A response must be received from each command before proceeding.

Desired Action	Command	Command Meaning
Take control of marker	Send: 2 Receive: 0	Take Control Acknowledge OK
Load Jobs from Flash or USB to RAM for fast switching. Repeat for all desired jobs or until RAM full.	Send: 205,jobname.dat Receive: 0	Load from Flash
Select Job loaded named "XYZ.dat"	Send: 201,XYZ.dat Receive: 0	Make job XYZ active OK
Populate memory buffer field 1 with variable data. Objects in job already configured to use memory buffer 1.	Send: 22,1,12345678 Receive: 0	Set MB#1 to 12345678 OK
Check memory buffer 1	Send: 23,1 Receive: 12345678	Check MB#1 OK
Execute Job Once. Observes External Start settings in job configuration	Send: 207,1 Receive: 0	Execute job
Poll execution status for completion or monitor external I/O. Continue once status is again idle.	Send: 214 Receive: 2, if busy 1, if idle	Poll for status
Select Job loaded named "ABC.dat"	Send: 201,ABC.dat Receive: 0	Make job ABC active OK
…etc…	…etc…	…etc…
Release control	Send: 3 Receive: 0	Release API control OK

Tips on using the TCP/IP Interface

In order for you to communicate with the LEC over TCP/IP, you must know the IP address and Port of the LEC.

By default, the LEC makes the Remote Command API Interface service available on Port 12500. The LEC can be configured to use a Static IP address, or to request an IP address each time it starts from a DHCP server. It is recommended in situations where the LAN-based Remote Command API is used, to configure Static IP addressing for the LEC. Using this approach, the Remote Command API client will know the IP address of the LEC without having to use other discovery techniques.

Remote control of the LEC can be established by any client computer that supports TCP/IP networking. This includes computers running *Microsoft Windows*, *Linux*, or other operating systems. Communication with the board is established by opening a socket connection using the IP address on port 12500.

API Command Set

The complete list of API commands is located in Appendix D. The interface provided by the Remote Command API is a message (character string) based protocol. All command strings must be terminated by a line feed, and all response strings are terminated by a line feed. The following list describes all the Remote Interface commands and their intended use, and is sorted in alphabetical order. Commands with multiple parameters are sent in comma delimited format, and responses with multiple parameters are returned in comma delimited format.

Note that all commands are text strings and are expressed in the table enclosed in quotes (" "). The quotation characters are ***NOT*** part of the command. This is also true for responses. Commands and arguments are case-sensitive.

The following convention will be used when indicating additional parameters: For example, to set the local IP address:

"506,ipaddress" is sent to the API as **506,192.168.42.1** (without exclamation marks).

A description of the command parameters follows each command.

Remote Command API List

For the complete list of commands, see *Appendix D, Remote Interface Commands*.

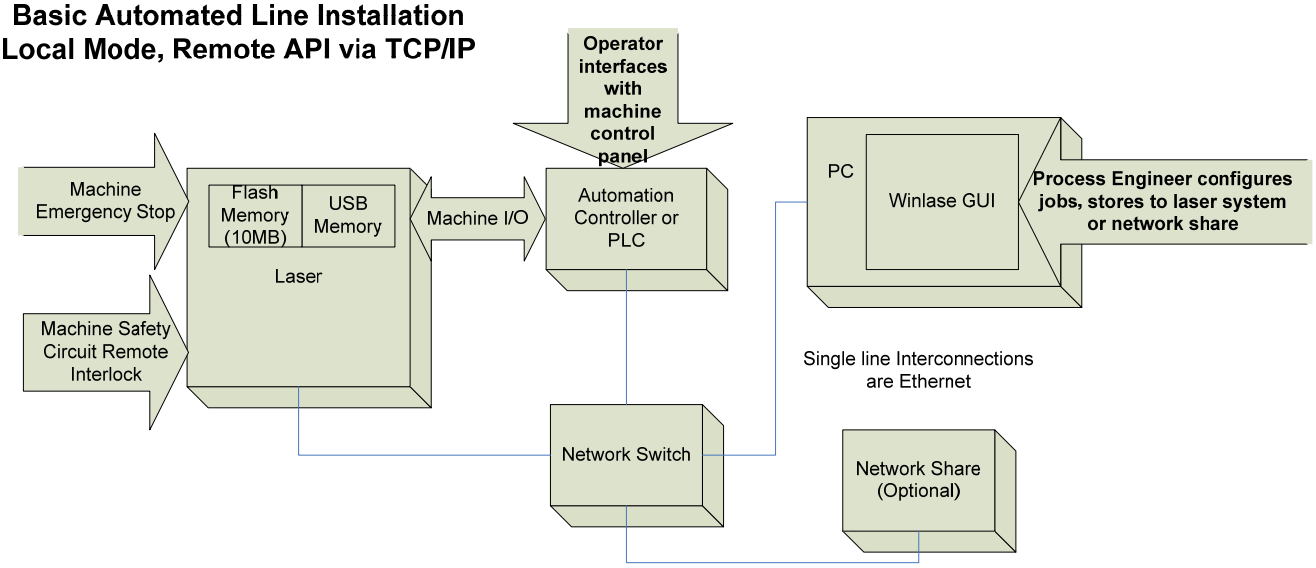
I/O Job Selection – Up to 255 Jobs

I/O job selection timing can be found in *Appendix B, Connections*. Software configuration is covered in *Chapter 3, Operating Instructions.* I/O Job Selection allows the user to set an 8-bit bit pattern from 1-255 and load jobs using the Job Load input. The user observes the marker's Job Ready for Mark output to determine the job load status. Job 0 can be used as an abort/clear or to reset the system after an interlock event.

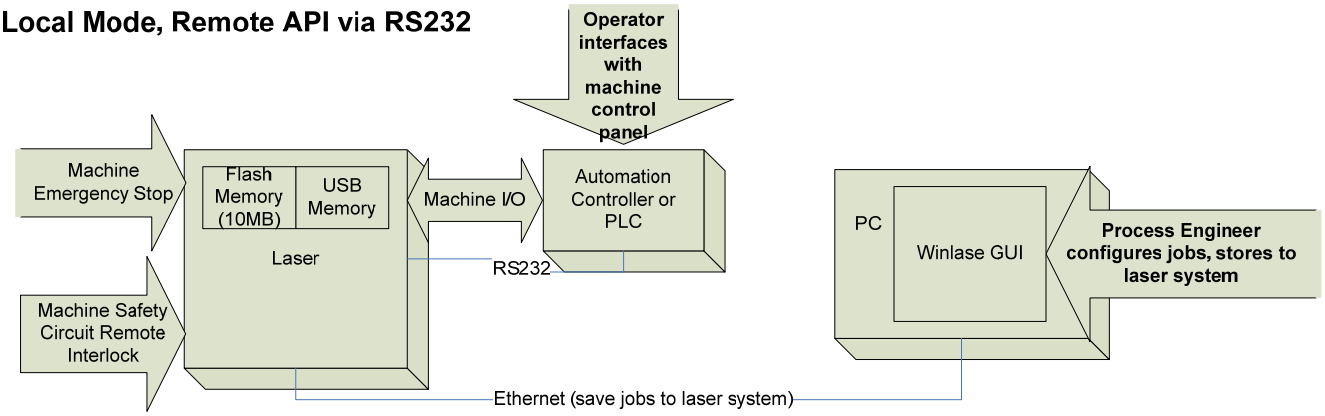
There are two performance modes in I/O Job Select – Standard and Cached. In standard mode the jobs are loaded from flash or USB memory to RAM at the time of the job load command. This requires additional time as the jobs are loaded but you can have >10MB of jobs available. In cached mode the laser marker caches all jobs in RAM at boot time and ensures switching times <25ms. This can only be performed when the amount memory required is less than available RAM, typically 10MB. Use Cached mode for a small number of jobs that need to be switched between rapidly and standard mode when speed is not required or many jobs are necessary.

Block Diagrams: Typical Stand-alone Mode Installations

Basic Automated Line Installation
Local Mode, Remote API via TCP/IP



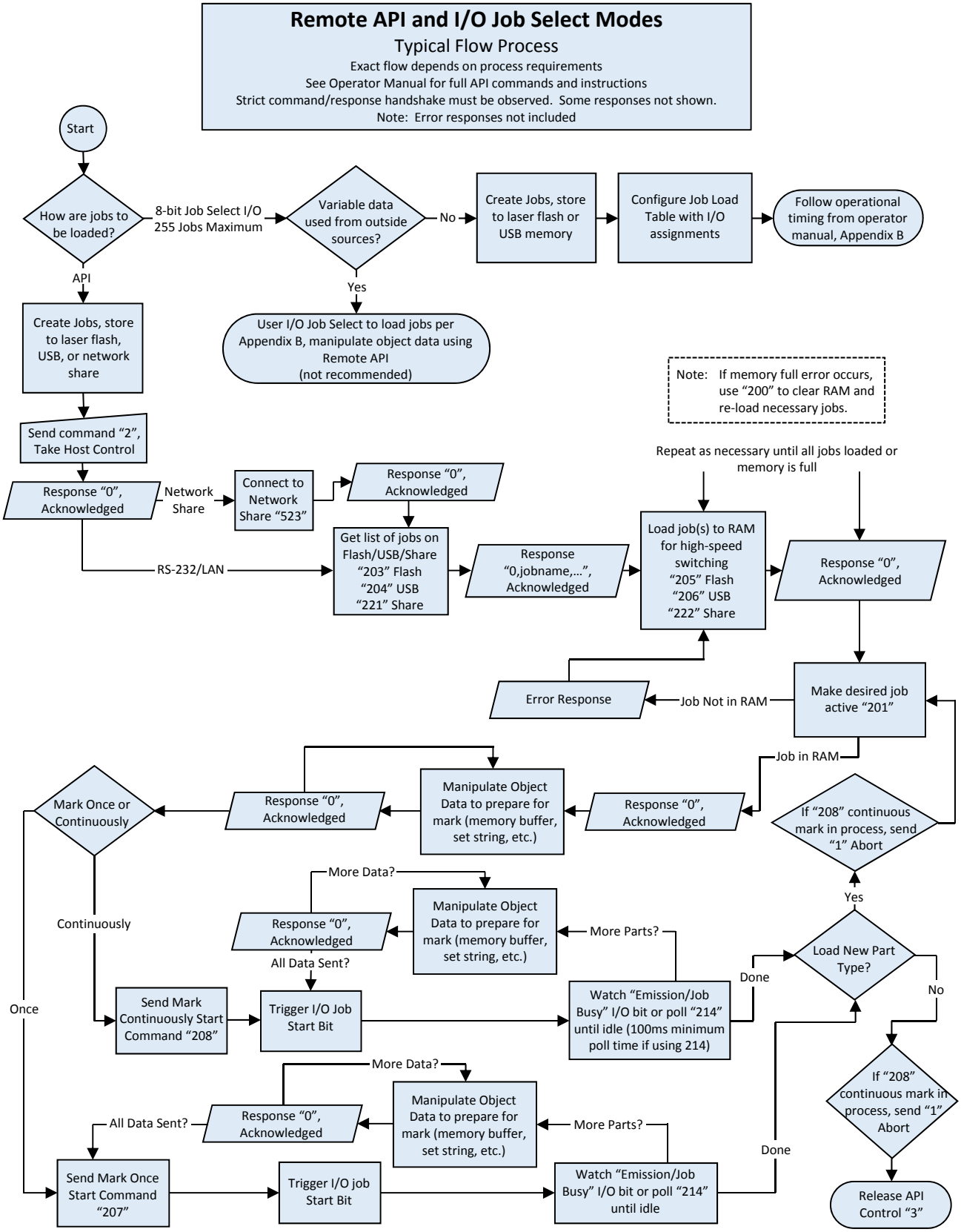
Basic Automated Line Installation
Local Mode, Remote API via RS232

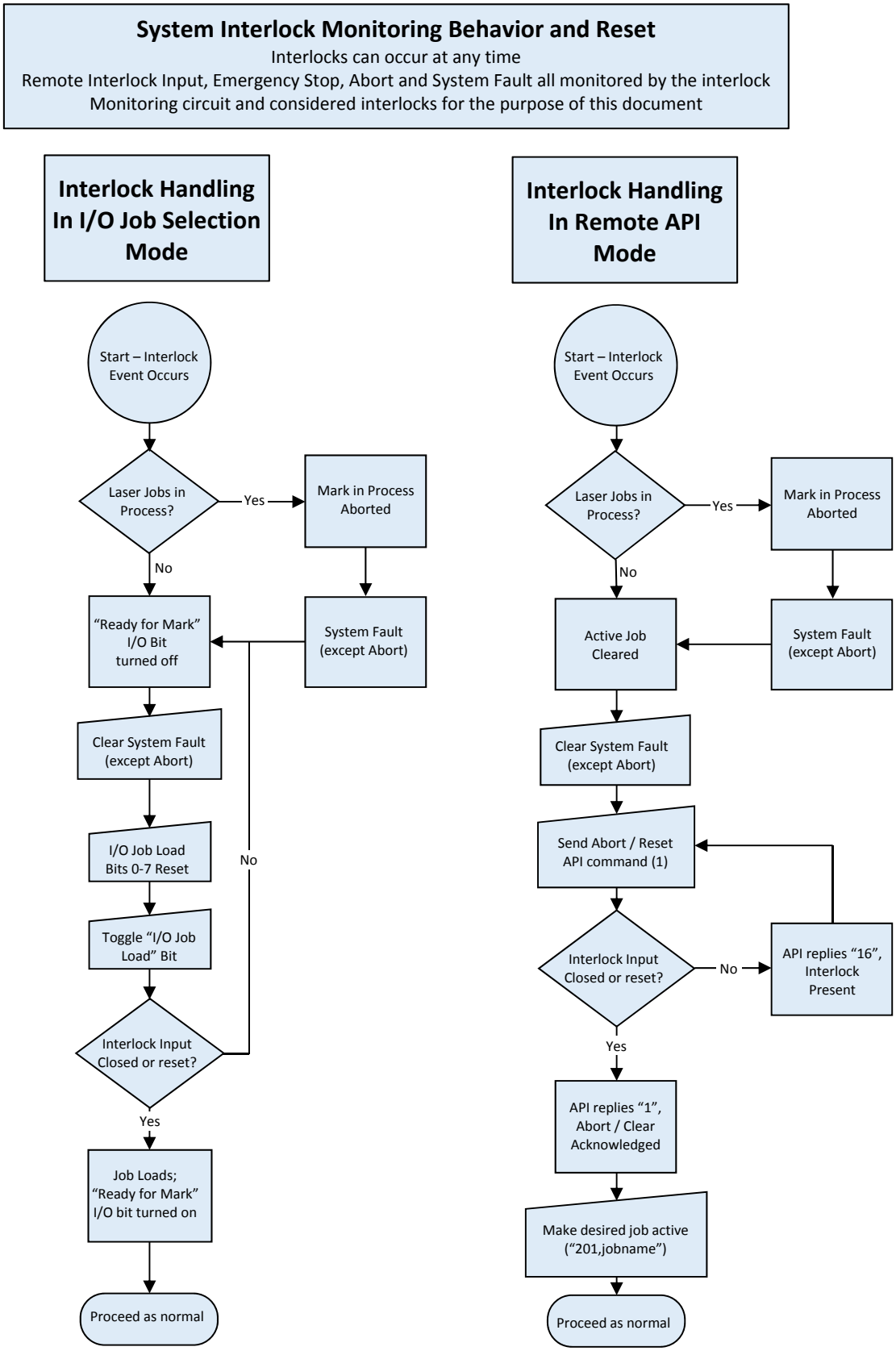


Integration Notes: Automated Line Installation Operating In Local/Stand-alone Mode

This configuration is used for a fully automated process flow where the laser process is controlled by an outside automation controller or PLC.

- Verify that all desired features are available in this mode. Two examples of features that may be incompatible depending on firmware version: QR Codes, *Marker Motion*™.
- In this mode all jobs are stored locally to the laser onboard flash memory or to a USB memory stick. In TCP/IP implementations the jobs can also be stored to a *Windows* network share on the factory network for systems with firmware version > 6.x.
- The process or manufacturing engineer configures and maintains the *WinLase* jobs according to engineering documentation using a PC running *WinLase* software. The PC does not need to be near the laser system as long as they can see each other on the network. Other common implementations include network or tablet PCs brought to the machine for programming/configuration.
- One PC can administer multiple laser markers in this mode.
- Once all *WinLase* jobs are created they must be saved to the laser system. At this point the PC can be removed.
- The automation controller takes control of the laser marker and proceeds with the marking process.
- The marking process follows the Remote API process flow to manipulate data and mark the job as detailed in the flowchart section.
- It is necessary to observe a strict one-command-one-response handshake to prevent sequence errors or missed commands.
- Once a **Run Job** command is issued the laser marker will check the status of the **Start Job** input bit and proceed once the appropriate input is received.
- The PLC should watch the Emission (aka **Job Busy**) signal or poll the API to verify that the job is completed.
- If any interlock input occurs, it is necessary to follow the Interlock Handling procedure detailed in the flowchart section.
- Clear any errors per the procedures in the operator manual timing diagram section.
- Mark on the Fly is only available in API mode.
- When a custom GUI is required it is usually better to have the GUI control the laser in a Stand-alone implementation rather than use the COM server streaming mode directly.


Remote API and I/O Job Select Modes
Typical Flow Process
Exact flow depends on process requirements
See Operator Manual for full API commands and instructions
Strict command/response handshake must be observed. Some responses not shown.
Note: Error responses not included
Start
How are jobs to be loaded?
8-bit Job Select I/O
255 Jobs Maximum
Variable data used from outside sources?
No
Create Jobs, store to laser flash or USB memory
Configure Job Load Table with I/O assignments
Follow operational timing from operator manual, Appendix B
API
Yes
Create Jobs, store to laser flash, USB, or network share
User I/O Job Select to load jobs per Appendix B, manipulate object data using Remote API
(not recommended)
Note: If memory full error occurs, use "200" to clear RAM and re-load necessary jobs.
Send command "2", Take Host Control
Repeat as necessary until all jobs loaded or memory is full
Response "0", Acknowledged
Network Share
Connect to Network Share "523"
Response "0", Acknowledged
RS-232/LAN
Get list of jobs on Flash/USB/Share
"203" Flash
"204" USB
"221" Share
Response "0,jobname,...", Acknowledged
Load job(s) to RAM for high-speed switching
"205" Flash
"206" USB
"222" Share
Response "0", Acknowledged
Error Response
Job Not in RAM
Make desired job active "201"
Job in RAM
Mark Once or Continuously
Response "0", Acknowledged
Manipulate Object Data to prepare for mark (memory buffer, set string, etc.)
Response "0", Acknowledged
If "208" continuous mark in process, send "1" Abort
Yes
More Data?
Continuously
Response "0", Acknowledged
Manipulate Object Data to prepare for mark (memory buffer, set string, etc.)
More Parts?
Load New Part Type?
Done
No
All Data Sent?
Once
Send Mark Continuously Start Command "208"
Trigger I/O Job Start Bit
Watch "Emission/Job Busy" I/O bit or poll "214" until idle (100ms minimum poll time if using 214)
More Data?
If "208" continuous mark in process, send "1" Abort
Response "0", Acknowledged
Manipulate Object Data to prepare for mark (memory buffer, set string, etc.)
All Data Sent?
More Parts?
Done
Send Mark Once Start Command "207"
Trigger I/O job Start Bit
Watch "Emission/Job Busy" I/O bit or poll "214" until idle
Release API Control "3"


System Interlock Monitoring Behavior and Reset
Interlocks can occur at any time
Remote Interlock Input, Emergency Stop, Abort and System Fault all monitored by the interlock Monitoring circuit and considered interlocks for the purpose of this document
Interlock Handling In I/O Job Selection Mode
Start – Interlock Event Occurs
Laser Jobs in Process?
Yes
Mark in Process Aborted
No
"Ready for Mark" I/O Bit turned off
System Fault (except Abort)
Clear System Fault (except Abort)
I/O Job Load Bits 0-7 Reset
Toggle "I/O Job Load" Bit
Interlock Input Closed or reset?
No
Yes
Job Loads; "Ready for Mark" I/O bit turned on
Proceed as normal
Interlock Handling In Remote API Mode
Start – Interlock Event Occurs
Laser Jobs in Process?
Yes
Mark in Process Aborted
No
Active Job Cleared
System Fault (except Abort)
Clear System Fault (except Abort)
Send Abort / Reset API command (1)
Interlock Input Closed or reset?
No
API replies "16", Interlock Present
Yes
API replies "1", Abort / Clear Acknowledged
Make desired job active ("201,jobname")
Proceed as normal

Section V: Using the TCP/IP and RS-232

Streaming Mode Host Interface

NOTE

This mode is ***not*** recommended unless no other options are available since it has a limited command set and certain limitations compared to other modes. When possible it is better to select the Remote API instead of the Host interface.

The Host interface is a special variant of streaming mode that combines many of the capabilities of the remote API with streaming mode. With *WinLase* running in the background a remote device such as a PLC can connect to the *WinLase* Host interface and remotely control the laser marker.

In terms of simplicity, the RS-232 port is easier to set up than the TCP/IP interface, because the cable connection between the two computers is direct and troubleshooting is much easier because HyperTerminal can be used to troubleshoot the connection.

TCP/IP, on the other hand, is a Client/Server protocol that is a bit more difficult to set-up. In order for you to communicate over TCP/IP, you must know the IP address and Port of the device you are communicating with.

By default, *WinLase* makes the Remote Interface service available on Port *350*. This can be changed in the **Host Interface** setup box if Port 350 conflicts with another installed port on your machine. Determining the IP address of the computer that *WinLase* is running on depends on how the TCP/IP stack is configured in *Windows*. Computers can either have a static IP address, or one that is dynamically allocated when the computer signs on to the network.

RS-232 and TCP/IP Commands and Functions

The interface provided for RS-232 and TCP/IP is textual; commands are sent over either port as ASCII text strings. These strings are interpreted by *WinLase*, and are executed accordingly.

RS-232 and TCP/IP Command List

For the complete list of Host mode commands, see *Appendix D, Remote Interface Commands*.