ProWriter™ F20 LASER MARKING SYSTEM

www.controllaser.com

Operations Manual

2419 Lake Orange Drive, Orlando, FL 32837
Telephone 407-926-3500 Fax 407-926-3590
www.controllaser.com

Table of Contents

Preface

Introduction

This manual covers safety, system specifications, installation, maintenance, basic troubleshooting procedures, and operations. Diagrams and drawings will be included to assist in the description of components and layout of the ProWriter™ F20 in the Customer Services Manual.

WARNING

It is extremely important to read and understand Chapter 1, *Safety*, before attempting to operate the ProWriter™ F20 Laser Marking System.

Control Laser Corporation (CLC) welcomes suggestions for future editions of this manual. Please send your comments to:

Attention: Marketing
Control Laser Corporation
2419 Lake Orange Drive
Orlando, Florida 32837

E-mail: clcsales@controllaser.com

Please contact the Field Service department for information regarding the maintenance of the ProWriter™ F20.

Phone: 1-866-612-8619, Monday through Friday 8:00 a.m. to 5:00 p.m. EST

Fax: 407-926-3551, 24 hours a day, seven days a week

E-mail: clcsales@controllaser.com

For information about CLC, visit our website at **www.controllaser.com**.

About This Publication

Chapter Summary

Technical Support Directory - This directory explains how to contact CLC for technical support by telephone, fax, and e-mail; how to order parts; and how to return components for repair. Information about technical support programs, training classes, and the CLC website are included.

Chapter 1. Safety - This chapter describes how the ProWriter™ F20 fulfills the performance requirements established by the United States Title 21, Code of Federal Regulations, Subchapter J (21 CFR), and the European Standard EN 60825:1992. This chapter documents the users responsibility and safety precautions.

CAUTION

All users should read and understand the safety chapter before attempting to operate the ProWriter™ F20

Chapter 2. System Description - This chapter outlines specifications for the ProWriter™ F20. The following diagrams and descriptions are provided: control unit, marking head, system design (beam-steering), marking field, computer architecture, and system operation (software).

Chapter 3. System Function - This chapter provides diagrams and descriptions of the ProWriter™ F20 controls and step-by-step instructions for system startup and shutdown.

Chapter 4. Installation - This chapter explains proper procedures for receiving, inspecting, and unpacking the ProWriter™ F20. Space, environmental, and electrical requirements are described. Step-by-step instructions for installing safety interlocks and connecting electrical lines are included. Guidelines for moving and storing the system are also outlined.

Chapter 5. Software Setup - This chapter describes the basic features of the Laser Marking Studio™ (LMS). An overview of LMS is provided as well as directions for navigating. Other topics include setting passwords, help system, and accessing other applications.

Chapter 6. Creating and Running a Part-Marking Program - This chapter describes the main concepts involved in using the LMS software to create and run a part-marking program. It also describes how to set up a remote programming station and how to select the LMS editor that best meets your programming needs. Setting process parameter values (speed, power, and Q-switch frequency) are explained to achieve optimum marking quality. This chapter also describes testing and debugging programs and provides step-by-step instructions for loading and running programs.

Chapter 7. Software Commands - This chapter provides a Quick – Reference Guide to all of the software programming commands. For details on creating, editing, and lasing programs in the Visual and Command Editors, please refer to the online manual.

Chapter 8. Routine Maintenance - This chapter contains step-by-step instructions for maintaining the ProWriter™ F20 including inspecting and cleaning the galvanometer mirrors and focusing lens assembly.

Chapter 9. Troubleshooting - This chapter provides general instructions for troubleshooting the ProWriter™ F20 according to the laser status indicators.

Appendix A. Material Suitability to Laser Marking - This appendix lists the marking quality that can be achieved with the most common types of marking materials.

Appendix B. Replacement Part Numbers - This appendix contains the current part numbers for ordering additional parts.

Document Conventions

Special graphics, described below, are used in this manual to emphasize certain types of information.

When paired with a **CAUTION** notice, this emphasizes information about actions that might result in equipment damage.

When paired with a **WARNING** notice, this emphasizes information that might result in personal injury.

Revisions

If any changes occur after the printing of this manual, a Revision Page will be included in the back of this manual.

Technical Support Directory

Field Service Support

A qualified maintenance technician should troubleshoot the laser system before contacting the Field Service department. Attempting to isolate the source of the problem will make it easier for the field service technician to assist you.

Have the model name and serial number of the laser available when you contact Field Service. This information is located on the Data Sheet in the Customer Service Manual.

Support by Phone

The Field Service department can be contacted at **(1-866) 612-8619**, Monday through Friday, 8:00 a.m. to 5:00 p.m. Eastern Time.

After 5:00 p.m., an answering service will take your message and notify a field service technician of your requirements by the next business day.

Support by Fax

The Field Service department can be contacted by fax at **(407) 926-3551** 24 hours a day, including weekends.

Faxes received after business hours and on weekends will be responded to the next business day.

Support by E-mail

The Field Service department can be contacted by e-mail at **clcsales@controllaser.com**.

Support by Website

Visit our website at **www.controllaser.com** to learn more about Control Laser Corporation (CLC), our laser markers and engravers, and various applications.

Service and Maintenance Programs

The Field Service department offers several service and maintenance programs that provide expert on-site support from factory representatives. Programs may be purchased on a quarterly or annual basis. Contact Field Service for details at (1-866) 612-8619 or **clcsales@controllaser.com**.

Advanced Maintenance Training Seminars

Advanced maintenance training seminars are held once a month at CLC. Contact Field Service for enrollment information at (1-866) 612-8619 or **clcsales@controllaser.com**.

Product Warranty

The Customer Service Manual explains the warranty covering the ProWriter™ F20.

Parts Repair

If a laser component fails, contact Field Service immediately. Most repairs can be accomplished within 24-48 hours upon receipt of the component. Some power supply units may take additional time to replace/repair because they may require outside vendor participation.

Before returning any parts to CLC for repair/replacement contact Customer Service at (1-866) 612-8619. You will be supplied with a Return Material Authorization (RMA) number used to track the part during repair and shipping.

Return all components to CLC by United Parcel Service (UPS), Federal Express, or any local carrier that can track your package to:

Attention: RMA number
Control Laser Corporation
2419 Lake Orange Drive
Orlando, Florida 32837

Replacement and Spare Parts

In North America, replacement and spare parts must be ordered directly through CLC. Parts can be shipped overnight at the customer's request. Spare part kits and test equipment kits are also available.

See Appendix B, *Part Numbers*, for current part numbers of available ProWriter™ F20 parts and test equipment.

To order parts or a current parts catalog, contact Customer Service at Control Laser:

Attention: Customer Service
Control Laser Corporation
2419 Lake Orange Drive
Orlando, Florida 32837

Telephone: (1-866) 612-8619
Fax: (407) 926-3551

In Europe, replacement and spare parts may be ordered through Excel Technology GmbH at:

Roenstgenstr., 84
D-6100 Darmstadt
Germany
Telephone: 49-6151/9380-0
Telex: 49-6151/9380-25

See Appendix B, *Part Numbers*, for current part numbers.

Safety 1

CAUTION

Use of controls, adjustments, or performance of procedures other than those specified herein may result in exposure to hazardous radiation.

Recommendation

Control Laser Corporation (CLC) recommends the Safety chapter be read thoroughly by all personnel before operating or performing maintenance on the ProWriter™ F20.

Commitment Statement

The contents in this manual are not specific to the specific ProWriter™ F20 you purchased. See the Customer Service Manual for a complete listing of diagrams, drawings, labels, and parts.

Compliance Statement

The ProWriter™ F20 is certified by Control Laser Corporation as a Class IV product in accordance with Title 21, Code of Federal Regulations, Subchapter J, (21 CFR), and European Standard EN 60825:1992. Check your customer service manual for specific classification of your laser.

Compliance may be verified by contacting:

Office of Compliance (HFZ-312)
Center for Devices and Radiological Health
US Department of Health & Human Services
2098 Gaither Road
Rockville, MD 20850
Telephone: (301) 594-4654

Laser Radiation Wavelength

The ProWriter™ F20 emits infrared laser (IR) radiation at 1,062 nanometers (nm) and visible laser radiation (laser pointer) at 660 nanometers. The IR laser poses the greatest risk of injury if the safety precautions in this manual are not followed. The 660 nm radiation used as a locating beam (the laser diode) poses a less significant risk but still requires adherence to the safety precautions.

The specifications in the following chart are provided to assist the Laser Safety Officer (*see Responsibility of the Laser User below)* in evaluating the hazard potential of the laser. These specifications represent the "worst-case" potential for short-term, peak laser emission and should not be confused with the operational specifications given in Chapter 2, *System Description*.

Recommended Optical Density for Eyewear:

ProWriter™ F20 (IR)	6
ProWriter™ F20 (laser pointer)	4

Laser Radiation Specifications

Specification	IR	Laser Pointer
Wavelength:	1,062 nm (typ)	660 nm
Peak Power @ 20 kHz:	10 kW	n/a
Pulsewidth:	100 ns (typ)	n/a
CW Power:	20 W	0.5 mW
Divergence:	< 0.3mrad	< 0.3 mrad
Beam Size:	7.5 mm (typ)	1 mm

Responsibility of the Laser User

The performance requirements described in paragraphs 1-9 are defined by the United States government and the European Union as the responsibility of the laser manufacturer. The responsibility of **the user** is the safe use of the laser defined in ANSI Z136.1; the American National Standard for the Safe Use of Lasers; and Section Three of EN 60825 - Radiation safety of laser products, equipment classification, requirements, and user's guide.

These standards require the user to appoint a **Laser Safety Officer** to oversee the use of this equipment. This individual shall have the authority and responsibility to evaluate, monitor, and enforce the control of laser hazards. See the appropriate standard: ANSI Z136.1 in the United States of America and Section Three of EN 60825 in the European Union for the specific responsibilities of the Laser Safety Officer.

ANSI Z136.1 is issued by the American National Standards Institute (ANSI) as a recommended safety guide for the use of laser products in the United States of America. ANSI cannot enforce adherence to the guide. However, OSHA, the Occupational Safety and Health Administration, uses the guide as its inspection standard when it inspects workplaces that use lasers. Therefore, the guide carries the authority of the United States government. It is recommended the procedures outlined in the guide be followed when operating the ProWriter™ F20 and the user contact local and state authorities to determine if any additional regulations may apply.

ANSI Z136.1-2000 may be ordered from:

Laser Institute of America (LIA)
13501 Ingenuity Drive
Suite 128
Orlando, FL 32826-3009
Telephone: 407-380-1553
Fax: 407-380-5588
www.ANSI.org

EN 60825 is issued by the European Committee for Electrotechnical Standardization (CENELEC) as a safety standard for the manufacture and use of laser products in the European Union. It is enforced individually by the government of each member country of the European Union. For more information, please use the address, phone number, and/or web site below.

CENELEC
35, Rue de Stassartstraat
B-1050 Brussels, Belgium
Tel: +32 2 519 68 71
Fax: +32 2 519 69 19
www.cenelec.org

Performance Requirements

21 CFR and EN 60825 specify certain performance requirements (features) that must be incorporated into or provided with each laser product for radiation safety purposes. These features with an explanation of their function in the ProWriter™ F20 are described in sections 1-10 in this chapter.

1. Protective Housing

The laser radiation emitted by a Class IV laser product must be contained within a protective housing at all points where access to radiation is not required during normal operation of the product in the performance of the function for which it was designed. [21 CFR 1040(f)(1) and EN 60825, 4.2].

Laser radiation generated by the ProWriter™ F20 originates in the controller and is delivered via an optical fiber to the marking head assembly shown in Figures 1-1 and 1-2. The marking head assembly manipulates and focuses the laser beam at the workpiece. Laser radiation is

completely contained within the enclosed marking head assembly except where it exits to impact the workpiece.

In the standard marking head assembly configuration *(Figure 1-1, Figure 1-2)*, laser radiation is emitted downward when mounted vertically. The user can also mount the marking head assembly horizontally.

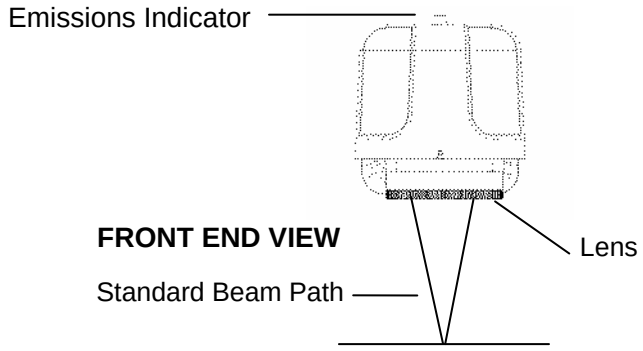


Figure 1-1. End View of Standard Marking Head Assembly Configuration

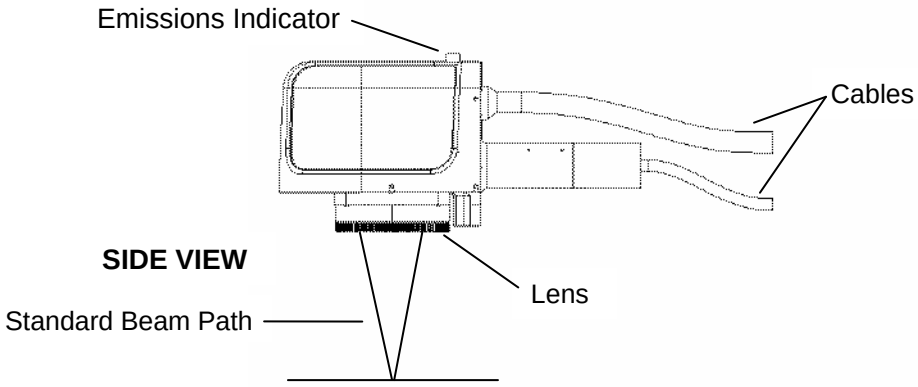


Figure 1-2. Side View of Standard Marking Head Assembly Configuration

WARNING

The ProWriter™ F20 marking head assembly contains no components requiring access during normal operation. The laser should never be operated without its cover except during authorized service functions requiring access.

The ProWriter™ F20 is certified as a Class IV product or otherwise stated in your CUSTOMER SERVICE MANUAL. Access to laser radiation is possible during operation and all personnel in the operating area must wear laser eyewear with an optical density (OD) as recommended on page 1-2.

2. Safety Interlocks

Any part of the protective housing that must be opened, removed or displaced during normal operation of the laser must be interlocked to prevent access to laser radiation. [21 CFR 1040.10(f)(2) and EN 60825,4.3].

No interlocks are required. It is not necessary to open or remove any part of the laser marking head assembly during normal operation.

3. Remote Interlock Connector

A Class IV laser must have a means to shut down the laser from a remote interlock. [21 CFR 1040.10(f)(3) and EN 60825, 4.4].

The remote interlock connector on the ProWriter™ F20 allows connection of external interlock circuits or switches for the control unit which can shutdown the laser. See Chapter 4, *Installation* for installation instructions.

4. Master Key Control

Each Class IV laser must be provided with a keyswitch which will prevent operation of the laser when the key is removed. The key must be removable only in the OFF position, and must disable the laser when removed. [21 CFR 1040.10(f)(4) and EN 60825, 4.5].

The master key control for the ProWriter™ F20 is located on the main control panel (*see Figure 1-3.*)

WARNING

The master key to operate the ProWriter™ F20 should be given only to personnel authorized by the Laser Safety Officer. The laser should never be left unattended while running or while the key is in the laser.

5. Emission Indicator

An emission indicator is required to provide visible signal during emission of laser radiation, and sufficiently prior to emission to allow a person to avoid exposure to laser radiation. [21 CFR 1040.10(f)(5) and EN 60825, 4.6].

There are two emission indicators on the ProWriter™ F20, one on the main control panel and a second on the laser marking head assembly. Both indicators light when the keyswitch is turned to the CONTROL ON position indicating the laser is being activated. The indicators remain on until the keyswitch is turned to the POWER OFF position. The keyswitch must be turned to the POWER ON position to activate the power supply that activates after a few seconds delay.

Figure 1-2 shows the emission indicator on the laser marking head assembly. The emission indicator on the control panel is the POWER ON indicator (*see Figure 1-3.*)

6. Beam Attenuator

A beam attenuator (safety shutter) must be provided to enable the user to terminate lasing without turning off the master keyswitch or main power switch. [21 CFR 1040.10(f)(6) and EN 60825, 4.7].

The shutter terminates lasing by blocking the laser beam before it reaches the output optics.

The ProWriter™ F20's safety shutter is located inside the sealed marking head assembly. The shutter is actuated when the shutter switch located on the control panel is moved to the "closed" position. The external interlocks connected to the remote interlock connector can also actuate the shutter.

7. Location of Controls

Controls which are necessary for operation of the laser must be located so they can operate without exposure to laser radiation. [21 CFR 1040.10 (f)(7) and EN 60825, 4.8].

All controls used to operate the ProWriter™ F20 are located in the control unit *(see Figures 1-3a and b.)* The marking head assembly connects to the control unit by an umbilical cord allowing placement of the marking head assembly anywhere within the radius of the cord.

CAUTION

The ProWriter™ F20 is a Class IV product or otherwise stated in your Customer Service Manual and should be operated in accordance with procedures in this manual, ANSI Z136.1, EN 60825:1992, and local procedures issued by the Laser Safety Officer.

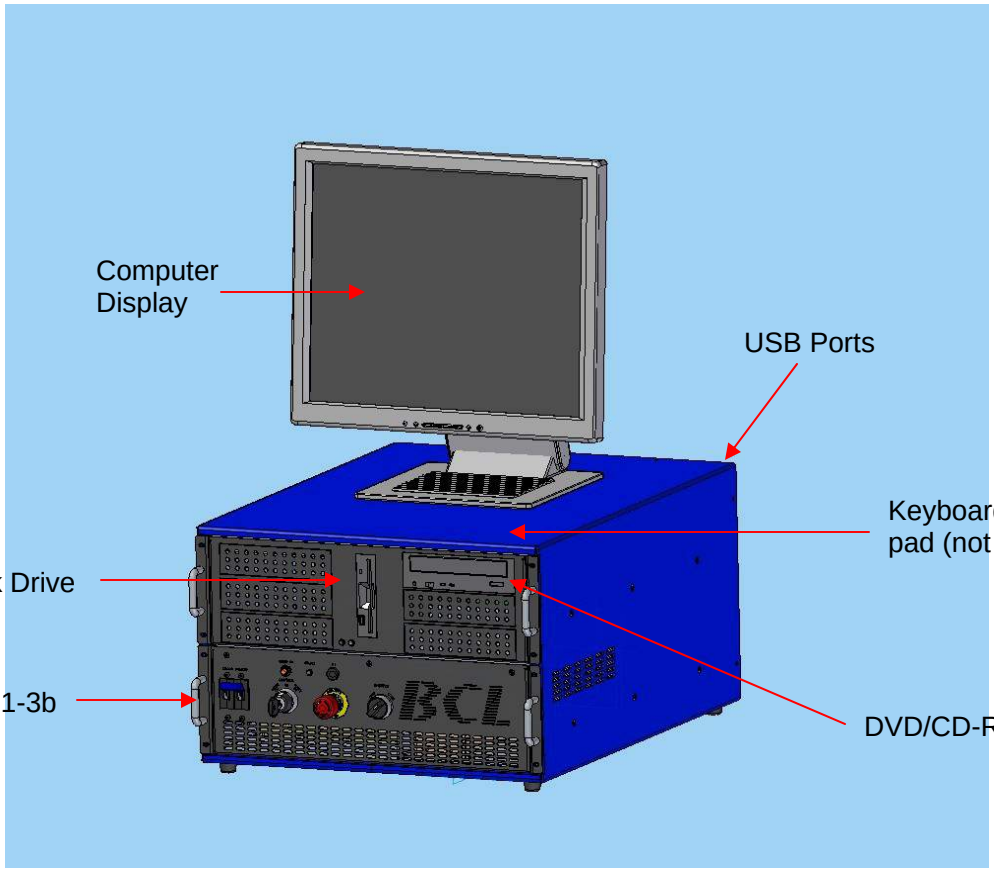


Figure 1-3a. ProWriter™ F20 Control Unit

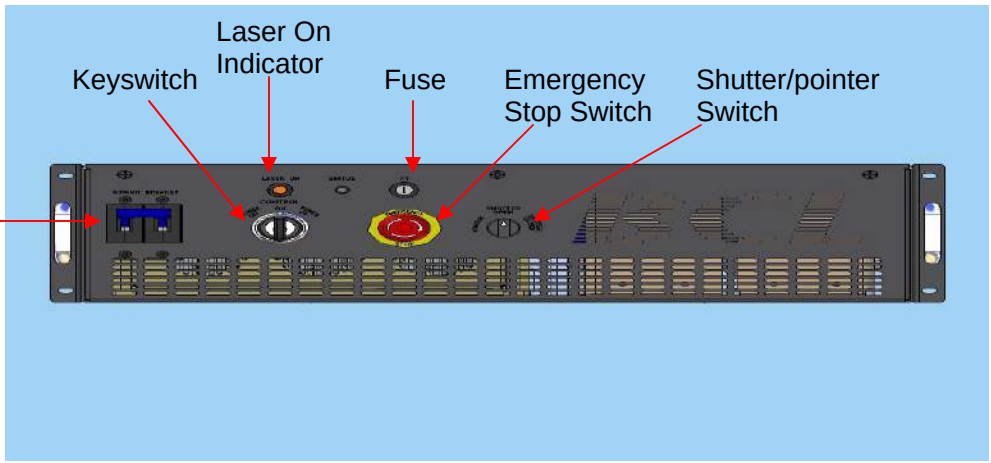


Figure 1-3b. ProWriter™ F20 Control Unit (bottom half)

Refer to *Figures 1-3a and b* for the location of the following controls:

1. Emergency Stop Switch

Press the Emergency Stop switch in to shut down the laser system.

The Emergency Stop switch turns off power to the laser. The control system remains on.

Turn the switch to the right to release the Emergency Stop switch (following the directional arrows).

2. Keyswitch

The keyswitch has three positions:

- **Power Off -** Turns off all systems. The key can be removed only in this position.
- **Control On -** Activates the laser's computer system and loads the ProWriter™ F20 software which can be operated in this mode.
- **Power On -** Activates the laser's power supply and internal cooling system.

CAUTION

Do not turn the keyswitch to the "Power On" position while a program is loading. This may cause the laser to start at higher than normal levels. This "hard" start may cause serious damage to the computer, drivers, and other key components.

CAUTION

When the keyswitch is in the Power On position, current is present and the system is capable of lasing.

3. Power On Indicator

Light illuminates to indicate that the system is capable of laser emission.

4. Mouse and Mouse Pad

5. Floppy Disk Drive

A 3.5 inch 1.4-megabyte floppy disk drive for program and data storage

6. DVD-RW Drive

7. USB Ports

8. Computer Keyboard

A standard keyboard is provided for laser software control and data entry.

9. Computer Display

A flat-screen LCD allows visual interaction with the laser's operating software.

10. Shutter/Pointer Switch

The shutter/pointer switch has three positions:

- **Pointer –** Activates the ViDAL (Visible Diode Alignment Laser) system. Users may select DRYRUN MODE or ALIGN RUN MODE. Either may be operated with the interlock disabled.
- **Shutter Open –** Opens shutter to allow the laser beam to pass through the galvo head.
- **Shutter Closed –** Closes the shutter to block the laser beam from passing through the galvo head.

8. Manual Reset

A class IV or otherwise stated laser in your Customer Service Manual must contain a mechanism requiring a manual reset to resume lasing following interruption through the remote interlock connector or from the loss of main electrical power. [21 CFR 1040.10 (f)(10)].

To restart the ProWriter™ F20 and resume lasing following shutdown through the remote interlock connector or the loss of main power:

1. Turn the keyswitch to the **Power Off** position.
2. Turn the keyswitch to the **Control On** position. The computer and control circuits restart.
3. Turn the keyswitch to the **Power On** position. The power supply restarts and restarts the laser.

CAUTION

Do not turn the keyswitch to the "Power On" position while a program is loading. This may cause the laser to start at higher than normal levels. This "hard" start may cause serious damage to the computer, drivers, and other key components.

9. Labeling

Labels must be affixed to each laser to identify the manufacturer, certify compliance with 21 CFR and EN 60825, provide warnings to the user about the wavelength, level, and location of accessible laser radiation present, and give precautions that should be taken to avoid exposure to the laser radiation. [21 CFR 1040.10(g) and EN 60825, 5].

Figure 1-4 at the end of the chapter illustrates the labels affixed to the ProWriter™ F20 in compliance with this requirement. For a complete and accurate showing of labels check your Customer Service Manual.

10. Documentation

Instructions must be provided that will enable the user to safely operate and maintain the laser. [21 CFR 1040.10(h) and EN 60825, 6.1].

It is recommended the Operations and Customer Service manuals be thoroughly studied by all personnel who have any responsibility for the laser prior to the laser's operation. The Operations manual gives instructions for proper operation and maintenance of the ProWriter™ F20. The manual also provides warnings and cautions that must be observed by the user to prevent unnecessary exposure to laser radiation.

Classification of Laser Functions

Laser products are classified according to the maximum level of laser radiation within human access during operation only. Levels accessible only during maintenance or service do not affect the classification. Therefore, it is possible for class I or class II products to contain class IV lasers. It is the responsibility of the manufacturer to determine whether specific functions are operation, maintenance, or service. The following definitions apply:

- **Operation -** Consists of functions by which the product accomplishes its intended purpose. These may include loading workpieces or documents and setting and manipulating external controls.

- **Maintenance -** Consists of functions performed by the user to assure performance. These may include cleaning and replacement of expendables.

- **Service -** Usually means repair. Service may be performed by specially trained service personnel or by sophisticated users following instructions specifically indicated as service instructions. Certain maintenance procedures will be considered service if they are infrequent, complex, or highly specialized.

The following chart lists the functions of operation, maintenance, and service associated with the ProWriter™ F20 described in this manual.

WARNING

All personnel in the vicinity of the laser while it is in operation must follow all prescribed safety procedures and use appropriate safety equipment. This includes wearing laser eyewear with an optical density (OD) as recommended on page 1-2. Failure to follow these instructions may result in the exposure of personnel to hazardous laser radiation.

Classification of Laser Functions

Function	Classification	Requires Lasing
Operation of Laser Controls	Operation	Yes
Cleaning Optics	Maintenance	No
Replacements of Electrical Assemblies & Components	Service	No
Replacement of Mechanical Components	Service	No
Replacement of Optical Components	Service	No
Troubleshooting & Repair	Service	**See Note**
Testing Following Repair	Service	**See Note**
Optical Alignment/Adjustment	Service	Yes
Programming	Service	No
Connections to Remote Interlock Connector	Service	No
Setup/Fixture Alignment	Service	No
Test Marking (following repair, programming, setup)	Service	Yes

Note: Some troubleshooting and testing functions will not require the laser to be lasing.

Electrical Safety

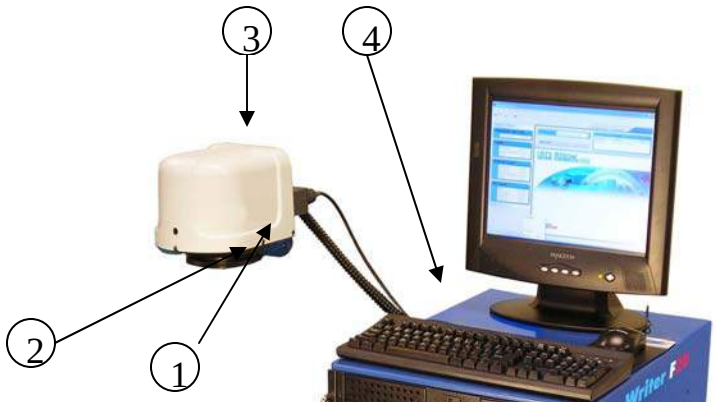
- Disconnect main power line(s) before working on any electrical equipment if it is not necessary for the equipment to be operating.
- After disconnecting power, wait at least five minutes for the capacitors to discharge through the bleeder resistors before touching any electrical equipment.
- Do not short or ground the power supply output. The power supply is not electrically isolated from the power line. Protection against possible hazards require proper connection of the ground terminal on the power cable and an adequate external ground. Check these connections at the time of installation and periodically thereafter.

- **Never** work on electrical equipment unless there is another person nearby who is knowledgeable of the operation and hazards of the equipment and who is competent to administer first aid.
- When possible, keep one hand away from the equipment to reduce the danger of current flowing through the body.
- Special measurement techniques are required for this system. Ground references must be selected by a technician who has a complete understanding of the system operation and associated electronics.

Use of Combustible Material

WARNING

A fire or explosion could occur if the laser beam is allowed to contact flammable or combustible materials. Care must be taken to ensure that such materials are kept away from any part of the laser beam path. (*See Figures 1-1 and 1-2*)



Label 1 and 2 are on both sides of the laser head..Label 3 is located on top of laser head and on inside frame. Lable 4 is located on side of laser cabinet

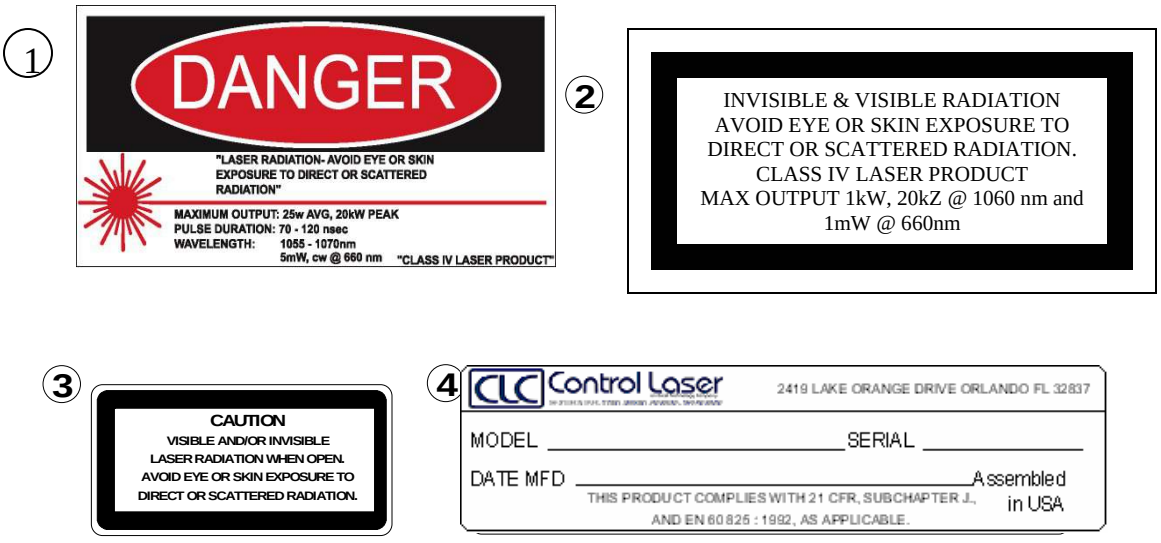


Figure 1-4. ProWriter™ F20 Labels Check Customer Service manual for additional labels.

System Description 2

Overview

The ProWriter™ F20 is a general-purpose industrial marking system. It is designed to permanently mark a variety of materials including hardened metals, ceramics, carbides, silicon, and plastics. It is capable of marking alphanumeric characters, barcodes, 2D matrices, and graphics. The system is computer-controlled and is easily adaptable to manual, semi-automatic, or fully automatic part handlers.

The ProWriter™ F20 consists of a control unit connected to the laser marking head assembly by an umbilical cord and fiber cable. The control unit contains power supplies, computer, fiber laser source, and power distribution boards.

For a general description of how industrial lasers work, see *Laser Basics* in Chapter 3, *System Function*.

Specifications

Performance

Marking field:	Working Distance (Effective Focal Length)	Depth of Field (Range of In-Focus)
4.0 in. Square (100 mm):	6.42 in. (163 mm)	.020 in. (1.02 mm)
6.0 in. Square (150 mm):	7.52 in. (191 mm)	.040 in. (1.02 mm)
12.0 in. Square (300 mm):	13.78 in. (350 mm)	.060 in. (1.54 mm)
Positioning Speed:	275 in/s (7000 mm/s)	
Repeatability:		
4.0 in. Square (100 mm):	+/- .000003 in.	
6.0 in. Square (150 mm):	+/- .000005 in.	
12.0 in. Square (300 mm):	+/- .000010 in.	
Writing Modes:	Linear, Ring, and Angular	

Character Fonts:	True Type fonts from Windows and special Laser Marking Studio™ (LMS) software fonts.
Graphics:	User-programmable Imports raster and vector graphics For a complete listing refer to the LMS help tab.

Laser Controller

Computer:

Marking controller:	IBM-compatible Pentium Type
Program Storage:	3.5 inch 1.4 MB floppy disk drive
	DVD/CD-RW drive, hard drive, USB ports
Video Display:	Flat-screen LCD, 1024 x 768 resolution
Diagnostics:	Self-diagnosis, operator-viewable

Wavelengths

Infrared (IR):	1,062 nm nominal

Laser Diode

Wavelength:	Visible red light at 660 nm

Mechanical

Control Unit:	23.0 inch L x 17.5 inch W x 12.0 inch H (584 mm L x 445 mm W x 305 mm H) ~97 lbs. (44 kg.)
Scanner:	8.5 inch L x 7.0 inch W x 7.0 inch H (216 mm L x 178 mm W x 178 mm H) ~10 lbs. (4.5 kg.)
Umbilical Length:	4.9 ft. (1.5 m) standard; 16 ft. (4.9 m) optional

Environmental

Operating Temperature:	33°F to 93°F (1°C to 33°C)
Storage Temperature:	14°F to 140°F (-10°C to 60°C)
Relative Humidity:	10% to 95% (non-condensing)
Atmospheric Pressure:	0 to 6,000 ft (760 to 604 mmHg)
Storage Life:	5 years

Cooling Requirements

Type of Cooling:	Forced air over heat sink

Utilities

Line Voltage:	115 VAC (+6%, -10% VAC) standard (50/60 Hz)
	230 VAC (+6%, -10% VAC) standard (50/60 Hz) (optional)
Current Consumption:	7 A (typical); 9 A (max.)
Normal Average Output:	20 watts

Control Unit

The ProWriter™ F20 control unit contains computers, drives, controls, and indicators as shown in *Figures 1-3a and b* in Chapter 1, *Safety*. Power and laser umbilical connections are located at the rear of the control unit.

Marking Head

The ProWriter™ F20 laser standard marking head configuration is shown in *Figure 2-3*. The laser beam emits downward.

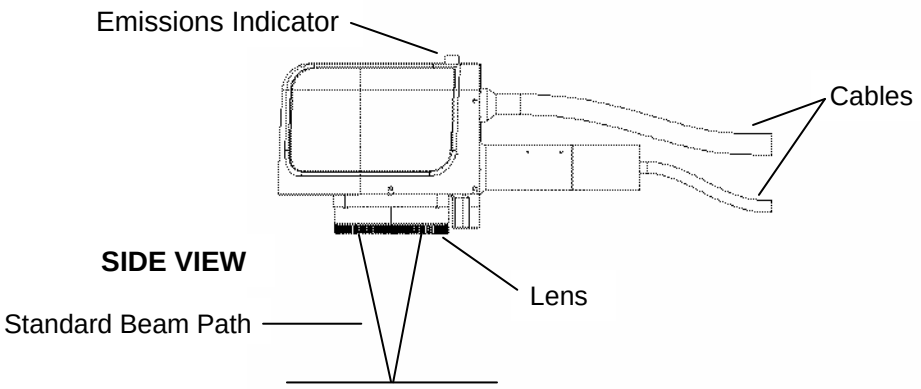


Figure 2-3. Side View of Standard Marking Head Assembly

System Design

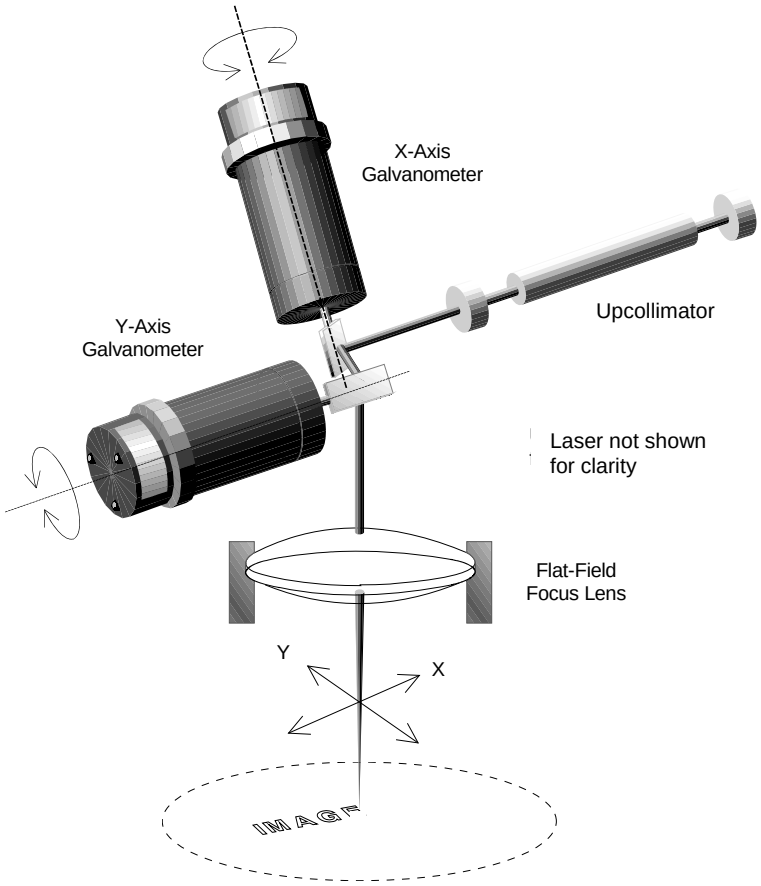


Figure 2-4. Post-focus Beam-steering Design

The galvanometer head contains two scan mirrors, each mounted on a high-speed, high-accuracy galvanometer. The galvanometers are mounted to provide independent beam motion on both the x and y axis of the marking field. The laser beam first reflects off the x-axis scan mirror then off the y-axis scan mirror. Computer signals move the mirrors steering the laser beam as it moves across the marking surface.

The flat-field lens assembly is the last optic the beam passes through before reaching the marking surface. The lens assembly focuses the beam reducing its diameter and increasing its energy density. The lens diameter has an equal corresponding marking field diameter.

The ProWriter™ F20 can be installed for manual, semi-automatic, and fully automated operation.

Marking Field

The ProWriter™ F20 has three fixed marking field sizes available in 4 inch, 6 inch, and 12 inch square fields (*see Figure 2-5*).

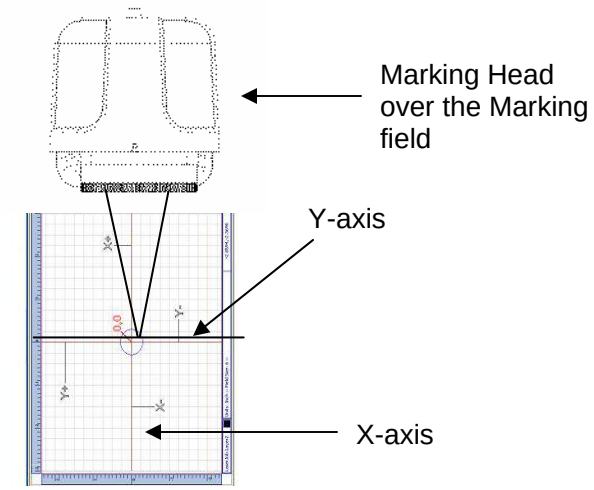


Figure 2-5. 6 inch Marking Field with a Marking Head Assembly

The marking field is defined as a Cartesian coordinate system. The coordinate system origin is in the center of the marking field. The **X-axis** of the coordinate system is **parallel** with the long dimension of the laser marking head. The **Y-axis** is **perpendicular** to the long dimension of the marking head.

Computer Architecture

The ProWriter™ F20 incorporates a Pentium class computer for the operator interface and program execution. All part program access, creation, editing, and operator input is performed on the system computer.

The system computer also executes part programs and controls the marking process.

System Function 3

Laser Basics

Overview

Laser is an acronym for Light Amplification by Stimulated Emission of Radiation. Simply stated, the laser is a light amplifier.

Lasers amplify light by absorbing and emitting energy. Absorption can be either electronic on the atomic level or rotational/vibrational on the molecular level. The emitted energy is a high-intensity beam of laser light.

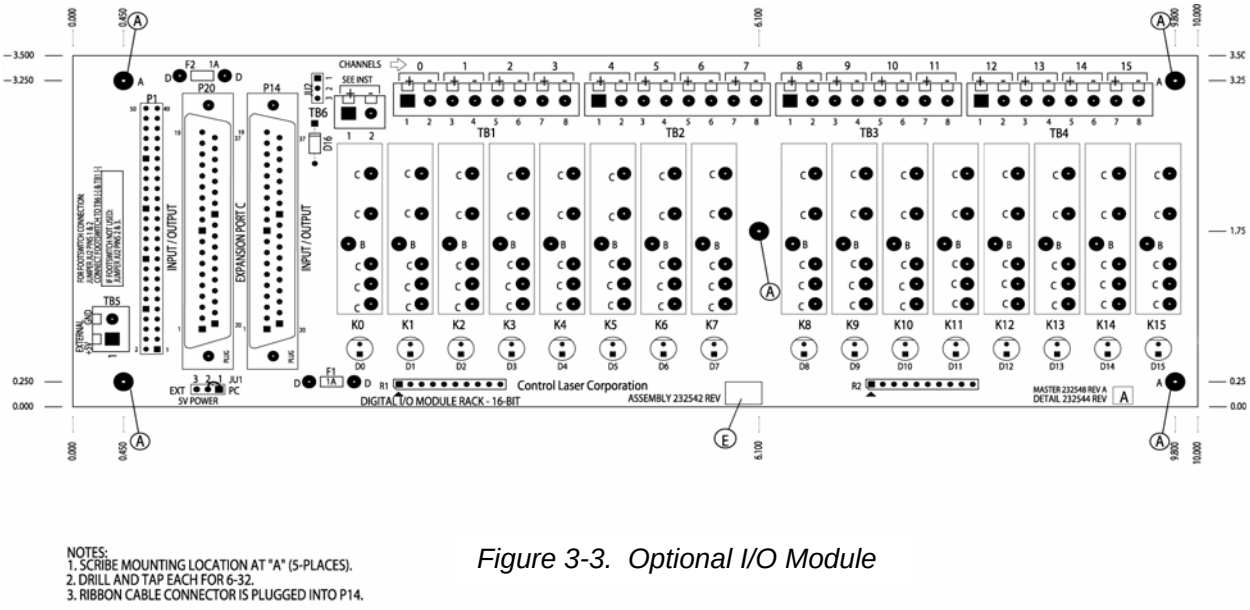
Lasers emit optical radiation which can be either invisible (infrared) or visible (laser pointer diode) light. Optical radiation is referred to as *non-ionizing* to distinguish it from *ionizing* radiation which is the type of radiation associated with X-rays and gamma rays. While overexposure to ionizing radiation such as frequent medical X-rays may cause health problems, the non-ionizing radiation emitted by lasers do not pose similar health risks even with frequent and long-term non-direct exposure.

Direct exposure to optical radiation can, however, pose serious health hazards to the skin and eyes. Lethal electrical hazards may also be present in **all** lasers. A laser-induced reaction on certain types of marking materials can release hazardous particles and gaseous products. Review Chapter 1, *Safety*, for instructions on how to avoid eye and skin injuries and electrical hazards. **Never** operate or service the ProWriter™ F20 without following the safety procedures specified in the safety chapter of this manual.

Optional Accessory Control Item (I/O Module)

User-Programmable eight Input and eight Output Modules

The user-programmable input/output lines are available as an optional accessory module purchased separately for the ProWriter™ F20. Many of the more sophisticated ProWriter™ F20 programming commands require this accessory. (*See Figure 3-3*)



NOTES:
1. SCRIBE MOUNTING LOCATION AT "A" (5-PLACES).
2. DRILL AND TAP EACH FOR 6-32.
3. RIBBON CABLE CONNECTOR IS PLUGGED INTO P14.

Figure 3-3. Optional I/O Module

The I/O lines act as interfaces between the laser computer system and any peripheral devices. There are 16 user-programmable I/O lines per module. Eight lines are for input and eight for output. A maximum of two I/O modules per ProWriter™ F20 are allowed for a maximum total of 32 user-programmable I/O lines.

Peripheral devices are connected to the I/O lines through Opto-22 modules.

The accessory I/O modules should be installed on a workstation separate from the ProWriter™ F20 control unit.

Each I/O line has a corresponding bit. A bit can be in one of two states: off (binary code 0) or on (binary code 1). When a bit is on, its LED on the I/O rack turns on; when a bit is off, the LED turns off. The Opto-22 module defines the type of signal (AC or DC) and voltage range used to change the state of the bit.

On the first optional I/O module, the 16 corresponding I/O bits are numbered 0 to 15 and are read from left-to-right. In the ProWriter™ F20 programming language, the I/O lines are always identified using this numbering system.

The first eight I/O bits (0-7) are **input** signals **to** the ProWriter™ F20 **from** outside devices and the last eight bits (8-15) are **output** signals **from** the ProWriter™ F20 **to** outside devices.

Bit zero (K0 on the I/O board) is dedicated for “start write” input. Each time a “start write” signal is sent the laser marks the currently loaded program. Bit eight (K8) is dedicated for “write complete” input. Each time the laser finishes marking a program the K8 bit tells the external equipment the laser is finished marking. Bits zero and eight cannot be used for any purpose other than start write and write complete, respectively.

On the second optional I/O module, the 16 corresponding bits are numbered 16 to 31 and are read from left-to-right. The first eight I/O bits (16-23) are **input** signals **to** the ProWriter™ F20 **from** outside devices and the last eight bits (24-31) are **output** signals **from** the ProWriter™ F20 **to** outside devices.

The following commands interface with the user-programmable I/O lines:

- **TSTBIT -** Forces the laser system to check the state of a user-programmable bit (input only)
- **CLRBIT -** Forces the laser system to clear (turn on) a user-programmable bit (input only)
- **SETBIT -** Forces the laser system to set (turn off) a user-programmable bit (output only)

For additional information on how to control the I/O lines through program commands, see the SETBIT, CLRBIT, and TSTBIT commands in the on-line manual.

System Startup Procedure

To start the ProWriter™ F20:

1. On the control panel, turn the safety shutter switch to the **Close** position.
2. Make sure the **Emergency Stop** switch is in the pulled-out position.
3. Insert the key into the keyswitch and turn to the **Control On** position. Windows™ XP and the software application, Laser Marking Studio™ (LMS), opens automatically and the status window displays.

   Note: Programs can be written at this point, with the system in the **Control On** state.
4. When ready to start marking, turn the keyswitch to the **Power On** position.

Hardware Status Monitor

The Hardware Status Monitor reports the status of hardware components to the operator. If the software application is unable to read any hardware sensors the corresponding indicator will show **Unknown**. See *Figure 3-4* below.

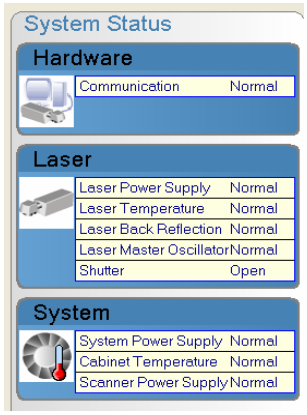


Figure 3-4. Hardware Status Monitor

Automatic Shutdown

When certain functions vital to laser operation fail, the laser system's safety interlocks are triggered. The power to the laser is turned off but the computer controls remain on.

The System Defaults Status dialog box will display and detail the fault or faults. When automatic shutdown occurs, see the Hardware Status Monitor and immediately contact a qualified maintenance technician.

Restarting the System

When automatic shutdown occurs, see the system log file Log.dat for a record of the events leading to shutdown. A qualified maintenance person should troubleshoot the cause of the shutdown. (See Chapter 9, *Troubleshooting*, for troubleshooting guidelines.) After the problem has been corrected, follow the instructions in *System Startup Procedure* in this chapter.

Manual Shutdown Procedure

To shut down the ProWriter™ F20 system manually, close the software and then exit Windows.

To exit LMS:

1. Press **<Alt> + <F4>** or click on **File > Exit**.
2. Turn the safety shutter switch to the **Close** position.

To exit Windows:

1. Click on 

at the bottom of the screen. The Start menu displays.

2. Select **Shut Down**. The Shut Down Windows dialog box displays.

3. Click on **Shut down** the computer.

4. At the confirmation prompt, click on **Yes**. Turn the keyswitch to the **Power Off** position when the computer shuts down automatically.

5. Remove the key from the keyswitch.

Emergency Shutdown Procedure

Press the red **Emergency Stop** switch on the front control panel. The power to the laser is turned off but the computer controls remain on.

To release the Emergency Stop switch, turn the switch to the right (following the directional arrows) and pull the switch up.

Installation 4

Receipt and Inspection

The ProWriter™ F20 is thoroughly inspected and carefully packed before leaving Control Laser's Corporation (CLC) factory. The carrier assumes responsibility for the unit's safe delivery. Any claims for loss or damage sustained in transit must be made against the carrier.

Carefully inspect the shipment upon receipt **prior to signing for the delivery**.

- Ensure the container is in an upright position as marked by the container labels.
- Check the shock and tilt indicators on the system. If one or more indicators are red inspect the system for damage. Contact the carrier immediately.

Any damage, loss, or discrepancies discovered during unpacking should be reported to the carrier immediately. Not immediately reporting damage or discrepancies of the shipment could result in the carrier refusing to honor a claim. All claims should be confirmed in writing as required by the carrier. For claim purposes, it is recommended all packing material be retained.

WARNING

Do not turn on the laser until the Safety and Installation chapters in this manual have been thoroughly read and understood and all installation requirements have been met.

Unpacking

1. Ensure the shipping containers are in the upright position as labeled.
2. Cut and remove any bands or straps from the container.
3. Carefully remove any packing material from the equipment.
4. Check the packing list against the equipment received. Report any discrepancies to both the carrier and CLC Field Service department (407-926-3550).
5. Ensure all packing lists, manuals, drawings, and accessory packages are removed from the packing material before it is stored. It is recommended to retain all packing materials.

In the unlikely event the laser must be returned, pack the laser or parts in a suitable container for shipping. CLC is not responsible for any damage on returned laser or parts.

The temperature where the laser is installed should not be less than 33°F (1°C) or greater than 93°F (33°C), non-condensing humidity.

Space and Environmental Requirements

The ProWriter™ F20 should be installed in an area as free as possible from the following:

- Contaminants such as dust and oil mist
- Combustible and flammable materials such as explosive fumes and gases
- Corrosives such as acid vapors
- The system should not be subjected to high energy level radio frequency emissions such as a two-way radio or broadcasting equipment.

CAUTION

The infrared laser emissions might interfere with the infrared sensors of nearby equipment.

The floor or foundation where the laser is installed must be level and firm. It must not be subjected to vibration or shock.

The temperature where the laser is installed should not be less than 33°F (1°C) or greater than 93°F (33°C), non-condensing humidity.

IMPORTANT:

- Do **not** turn on the laser if there is any condensation on the output casing of either the laser head or the control unit. Remove the condensation with clean warm air.
- **Never** place the unit in a location where excessive heat, moisture, or corrosive materials are present.
- If the system is moved into the working location from a cold environment, leave the system for a few hours to warm up before installing it.

Electrical Requirements and Connections

All ProWriter™ F20's use a standard 115 VAC (+6%, -10%), 50/60 Hz electrical plug connection or an optional 230 VAC (+6%, -10%), (50/60 Hz). Also refer to the electrical data tag on the system control unit cabinet to verify the input power requirements.

Installing Remote Options

The remote interlock connector on the ProWriter™ F20 allows connection of external interlock circuits or switches.

Installing Safety Shutter Interlock

Note: The following procedure is only used when the laser is integrated into a **Class I/II** certified workstation.

Connections are provided to attach external interlock switches to the safety circuit controlling the shutter. This feature allows the laser to be integrated into an enclosed workstation with the door(s) to the workstation protected by interlock switches wired into the safety circuit. When properly configured, the interlocks cause the laser to stop operation when the workstation door(s) is open. If the workstation has multiple doors, each door must have a separate interlock switch and all must be wired in series.

Interlock switches used on access doors of workstations must be of the type so the switch contacts electrically open to break the interlock circuit. Dual switches wired in a series may be used on each door to provide redundancy in the event of failure of one of the switches. Means of defeating or overriding safety interlocks are **not** recommended.

To install interlock switches:

1. Shut off the main electrical disconnect supplying power to the laser and appropriately tag and lock it out.

2. Use 22-24 AWG two-conductor jacketed cables appropriate to the environment. Run the cables from the external interlock switch to connector INT. Mount a normally open switch rated for 24 VDC @ 1-amp on the workstation. Connect the wires to the interlock switches. If multiple doors require interlock protection use a separate switch for each door and wire in series. Wires are jumpered for class IV operation.

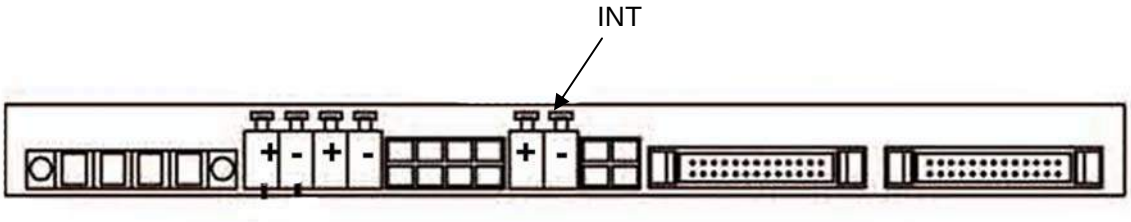


Figure 4-1. Laser Controller

Installing External Devices

Basic I/O

Start Write

An external signal from either a PLC or external power source, via a normally open switch, can be connected to the laser to begin marking of the currently loaded program each time a voltage is provided to the “start write” input. Activating this switch in a continuous or intermittent manner during program execution may result in improper marking operation. Refer to *Start Write Connections* for complete instructions. Various methods exist to establish a “start write” connection.

- Use of programmable logic controller (PLC)
- Use of an external power supply.

Write Complete

When the laser completes marking the program, a “write complete” signal equivalent to a contact closure is sent to the external equipment. The "write complete" function output accommodates 3-33 DC voltage @ 1-ampere max and is polarity sensitive.

Start Write Connections

Programmable Logic Controller (PLC)

This method requires connecting a PLC to the rear of the computer at the “start write” connections. Connect the output of the PLC to the input of the “start write”. The PLC is programmed to provide 3-33 VDC input pulse between 100ms-250ms in duration. After connecting the PLC, the options.txt file must be changed in the software. The options.txt file is located on the C drive at: c: drive/BCLC/LMS/LASERHI/options.txt. Open the file and change “IOIGNOR” from “0” to “1”.

External Power Supply

This method requires connecting an external power supply to the rear of the controller at the “start write” connections. After connecting the power supply, the options.txt file must be changed in the software. The options.txt file is located on the C drive at: c: drive/BCLC/LMS/LASERHI/options.txt. Open the file and change “IOIGNOR” from “0” to “1”.

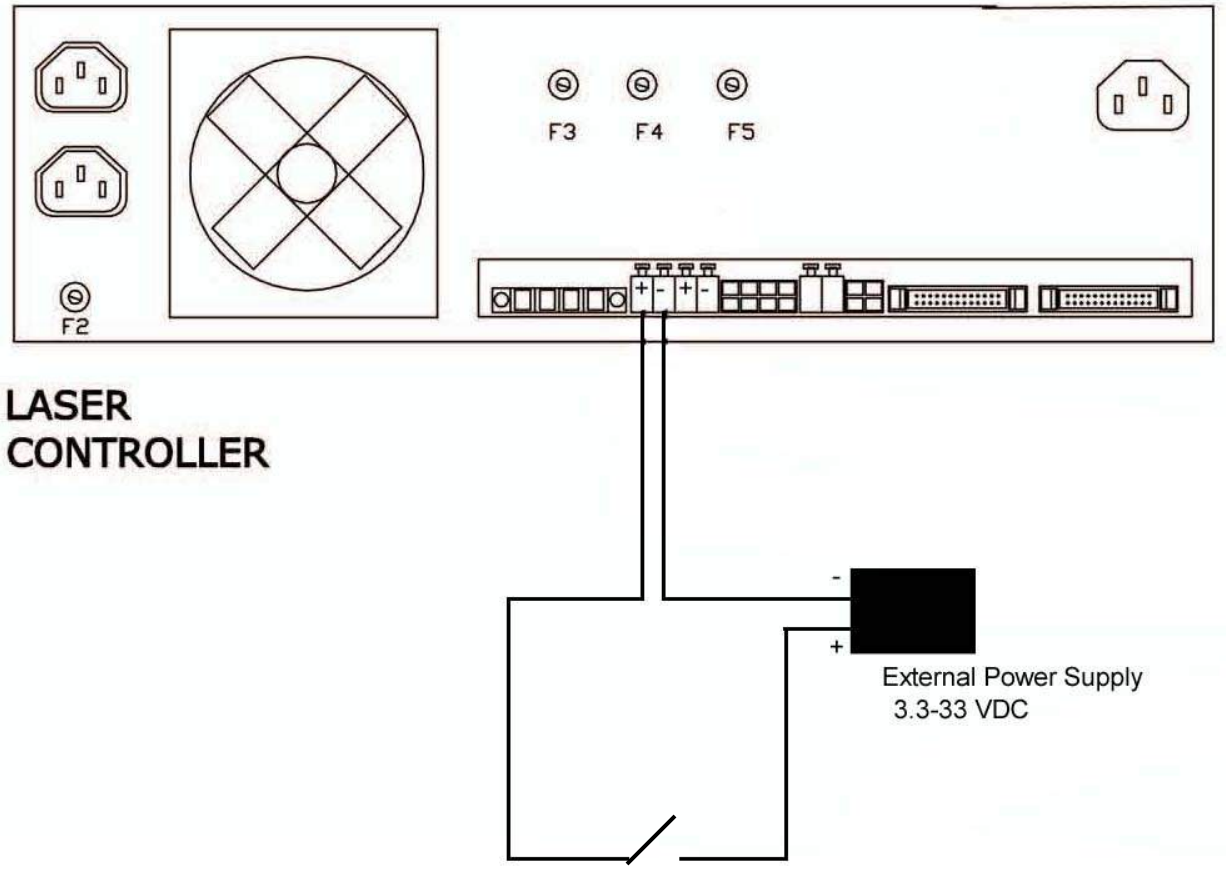


Figure 4-2. External Switch Connection

Installing the Optional I/O Module

The user-programmable input/output lines are available as an optional accessory module purchased separately. Many of the more sophisticated programming commands require this accessory.

There are 16 user-programmable I/O bits per module. The first eight bits are dedicated for input and the other eight bits are dedicated for output. (For more information about I/O modules, see *Optional Accessory Control Item* in Chapter 3, *System Function*.)

The I/O module may be installed within a workstation.

1. To locate the I/O rack assembly at a greater distance such as in a workstation, a "round-to-flat" type of ribbon cable is used for the interconnecting cable to be run through the conduit. *Figure 4-3* illustrates the I/O board assembly layout.

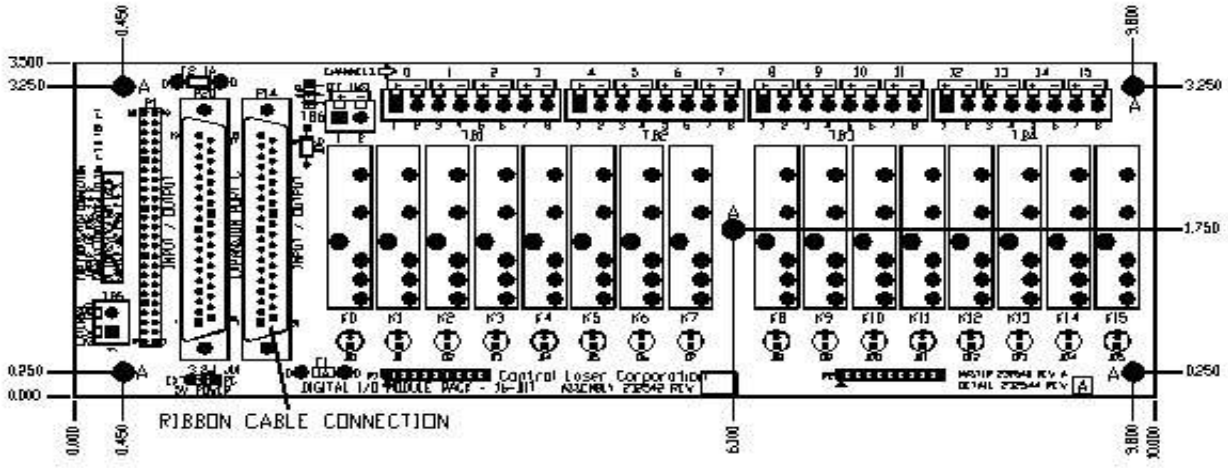


Figure 4-3. Optional I/O Module

Moving and Storing the ProWriter™ F20

Confirm the system's power requirements can be met if moving the ProWriter™ F20 from the original installation site. Check the environmental requirements outlined on page 4-2 *Space and Environmental Requirements*.

During moving, do not subject the laser system to vibration, excessive cold, or excessive heat.

The ProWriter™ F20 can be stored for up to 5 years. The temperature of the storage area ***must be between 14°F to 140°F (-10°C to 60°C).***

Software Setup 5

Overview

Laser Marking Studio™ (LMS) is a Windows-based software program. Drop-down menus, pop-up windows, dialog boxes, and toolboxes are provided to make navigation quick and simple.

Recommendation: Users unfamiliar with the Windows® operating system should consult a Windows® manual to learn basic navigation techniques before working with LMS.

The LMS software contains three main screens: Run Time, Design View, and Command Editor. All three of these can be accessed by clicking on the tabs located at the top right corner of any screen (see *Figure 5-1*).

Figure 5-1. Window Tabs

Both the Design View and Command Editor are capable of creating programs that satisfy basic part-marking needs. Each screen has a unique feature that makes it suitable for writing certain types of programs.

Run Time

Run Time is used **only** for loading and marking programs. It displays hardware status and the program's marking parameters. Editing **cannot** be done in this window. See *Figure 5-2a* for a view of the Run Time screen.

Use the Run Time view when:

- Running a program
- Checking the cycle time while running a program
- Using the Counter function to count how many times a program has been run

Figure 5-2a. Run Time

Design View

Design View contains a drawing screen for design and editing of images and adding basic commands. Programs are saved in the drawing (.lms) format. Different program layers can be viewed and/or marked at any given time. Programs in the .lms format load and run from this window. See *Figure 5-2b* for a view of the Design View screen.

Use Design View when:

- Creating one or more simple graphics
- The user is unfamiliar with basic programming concepts
- The user is comfortable in an intuitive, graphics-based programming environment

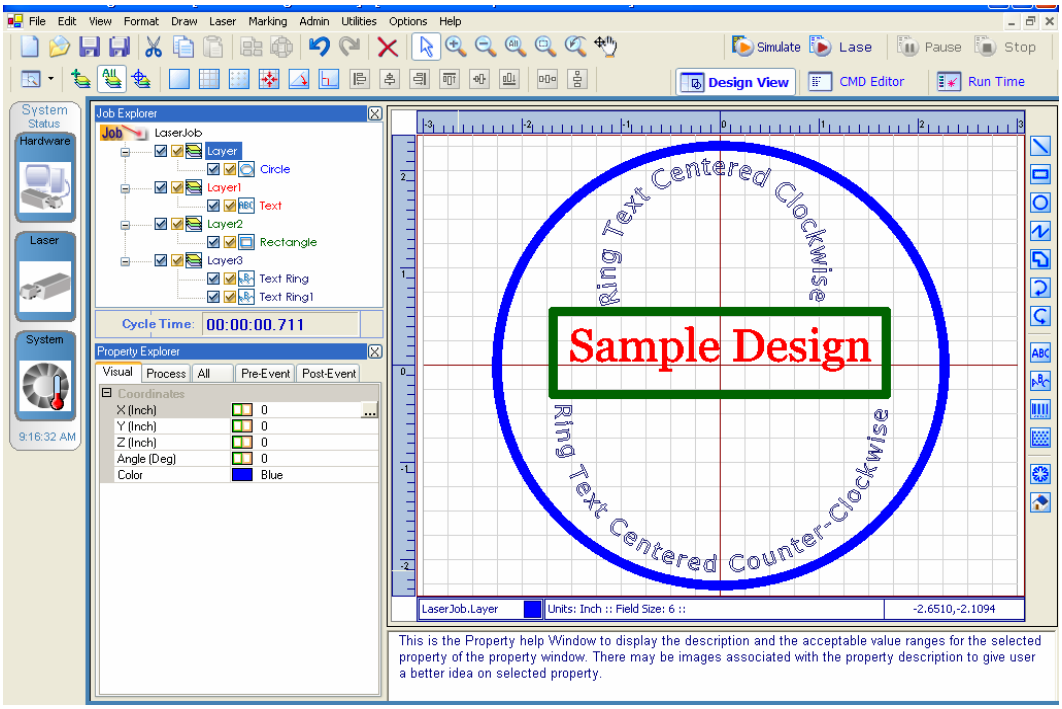


Figure 5-2b. Design View

Command Editor

Command Editor “writes” the programs and is saved and loaded in the command (.cmd) format. See *Figure 5-2c* for a view of the Command Editor screen.

Use the Command Editor when:

- The program does not require graphics or graphics have already been created in a separate graphics program
- The user is familiar with basic programming concepts
- The user is designing a program requiring programming commands

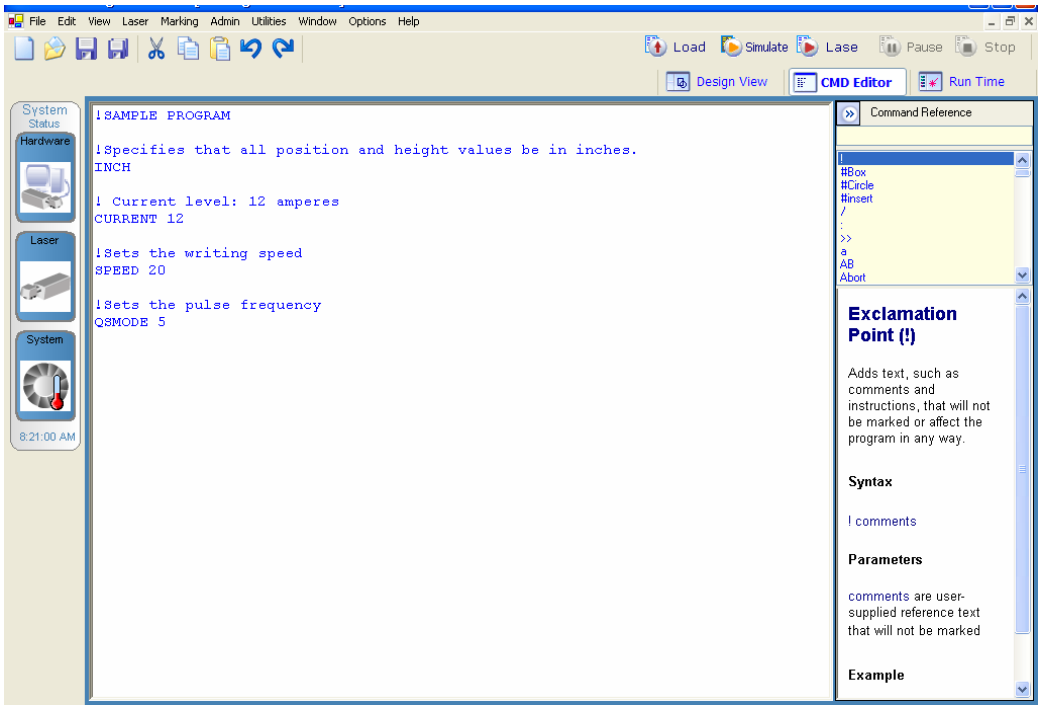


Figure 5-2c. Command Editor

System Organization

The ProWriter™ F20 incorporates two types of part-marking programs and three types of reference files into part-marking programs. (*See Figure 5-3*)

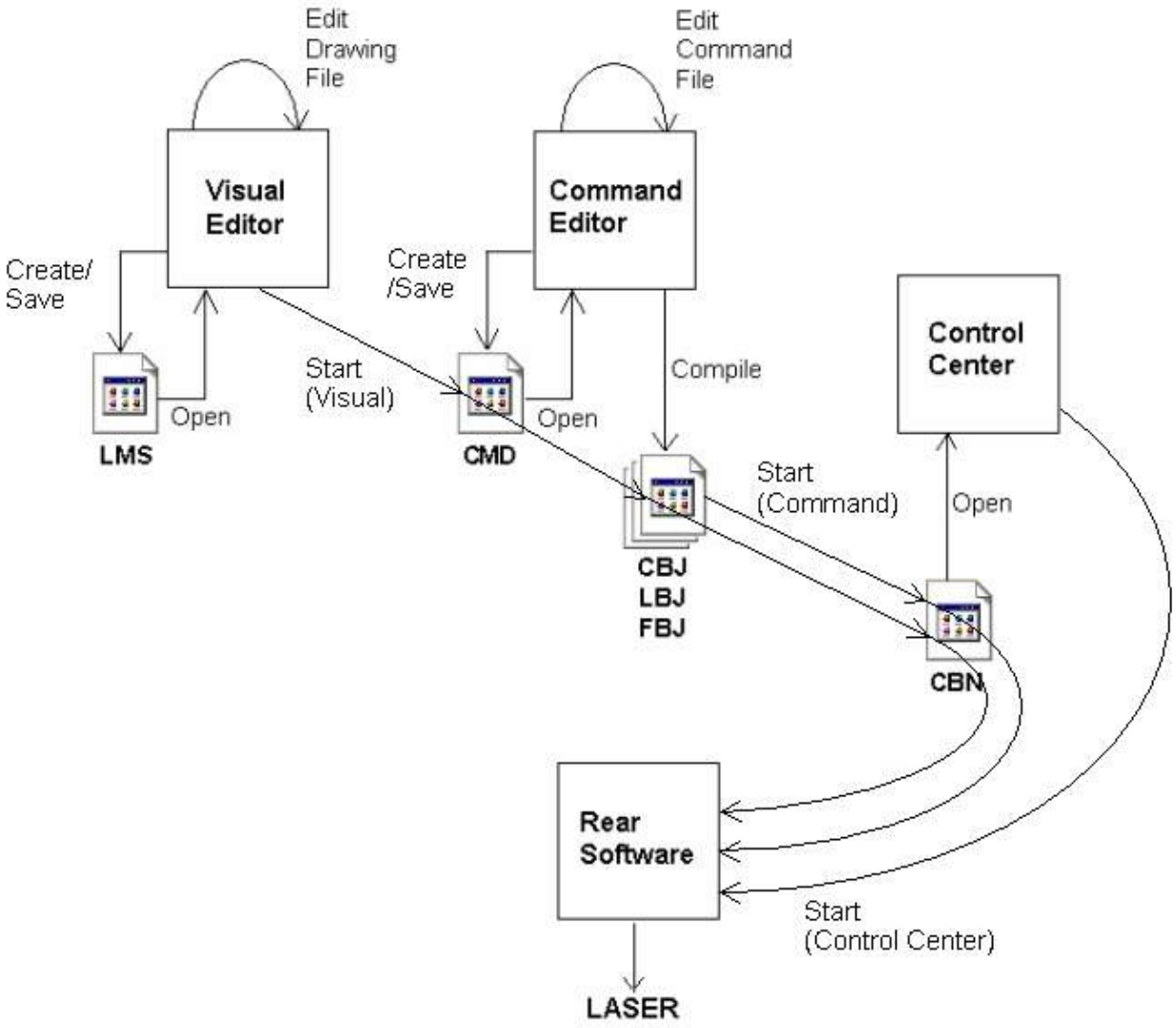


Figure 5-3. System Organization

Part-Marking Programs

- **Drawing (.lms) files -** Drawing objects with attached parameters and standard program controls
- **Command (.cmd) files -** Program command lines in the ASCII text format. Includes both standard and extended program controls

Reference Files

- **Logo (.log) files -** Graphic images originating from either bitmap or CAD files
- **Text (.txt) files -** ASCII text files
- **Font (.fnt) files -** Character font files

Secondary Files

- **Object (.cbj, .lbj, .fbj) files -** Compiler files associated with command, logo, and font files

User Accounts

LMS has three different user levels:

1. **Administrator -** full access to software including creating, deleting, and editing user accounts
2. **Engineer -** full access to software except to user accounts
3. **Operator -** may only run programs in the Run Time

File Utilization

Graphic images used in several different programs can be saved as independent logo files. Logo files are incorporated into .lms (Design View) files using the Logo tool in the Toolbox and into command files using the INCLUDE command.

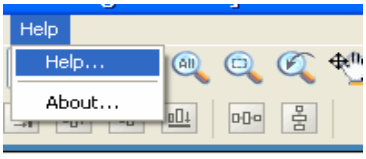
Alphanumeric text common to several command programs can be saved and referenced as separate text files. Optional font files can be used in addition to the pre-loaded character fonts.

During execution, part-marking programs accept real-time inputs from variables; operator input through CommScreens (Communication Screens) or Dialog messages; and serial and parallel I/O communications.

Help System

To access the Help System . . .

1. In the main menu, click on **Help**
2. **Help** opens in Internet Explorer



LMS contains an extensive help system in the Command Editor that includes the following:

- Full listing of all programming commands, complete definitions, and programming examples
- A special cut-and-paste method for creating command line programs from the help system's programming examples

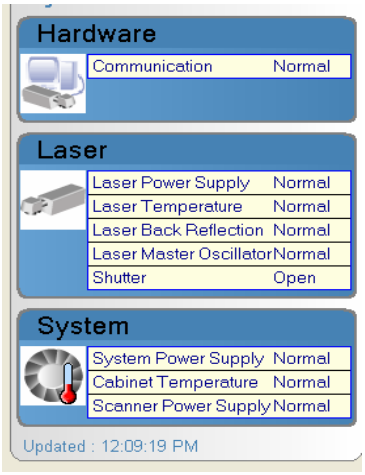
Making Selections

Main Menu and Toolbar

Run Time, Design View, and Command Editor have similar main menus and toolbars displayed at the top. These windows also have separate menus and tools, accessible only when working in that particular window.

Hardware Status Monitor

A Hardware Status Monitor indicates the status of the hardware components of the laser system. The Hardware Status Monitor is located on the left side of all three screens and informs the operator of component operating status and any malfunctions that may occur. Please see *Section 6.6 - Hardware Status Monitor* in the online manual for more information.



Hardware Status Monitor

Hot Keys

All program functions accessed by pointing and clicking the mouse also have a keyboard command or “hot key.” The hot key command may be a single function key or a combination of keystrokes.

Hot keys, where applicable, are noted in the toolbar and some hot keys are only applicable in certain viewing windows.

Setting the Marking Field Size

The proper marking field size for the laser is pre-set at the factory. The marking field size establishes the programming resolution and optimizes the operating system’s specific imaging requirements.

The Set Field utility is provided if the marking field size settings need changing. **Do not change the marking field size setting without first consulting a Control Laser Corporation technician.**

Viewing and Editing Default Settings

The ProWriter™ F20 has default factory settings for most major program controls. The default settings are provided to ensure the required major controls (i.e. power, speed) are always included in each program. They are not intended to be optimum settings for all marking programs. If one or more of these controls are not specified in a program the system automatically assigns the default value when the program is run.

Factory defaults also provide more efficient programming. For example, the default values for GST's (Galvanometer Settling Times) are designed to prevent marking inaccuracies such as overlapping corners in the majority of programs. There is no need to specify or change GST settings in a program unless marking results are unsatisfactory.

Default settings for programs created in both the Design View and Command Editor are displayed by clicking on **Options > Customize** in the Main menu. The default settings can be edited to meet specific marking needs. However, default settings are **not** saved to the .lms (Design View) and .cmd (Command Editor) files.

CAUTION

Use extreme caution when editing the defaults. Edits to the defaults are not saved to an individual file but to the Defaults window. Default values in the Laser Defaults window might affect any .cmd program run on the Marking Laser.

Avoid using custom default settings as a substitute for specifying control settings in a program.

After editing a field(s) in the Laser Defaults window click on **OK** to save the change. The new default settings are saved in lms.exe.settings.

6 Creating and Running a Part-Marking Program

Introduction

Control Laser Corporation (CLC) recommends the user use the comments identifier (“!”) command in all .cmd programs written in the Command Editor to detail the function of each program section. Companion .cmd files can be created for .lms programs (written in the Design View) and comments detailing the program can be included in the same manner.

The user should keep a written record that includes a printout of the program, a description of the program’s purpose, and any drawings, graphs, and flowcharts used to develop the program.

Setting Up a Remote Programming Station

Laser Marking Studio™ (LMS) may be installed on a desktop computer to establish a remote station for writing programs and saving valuable system production time. Click on the LMS icon to write and edit programs in either the Design View or Command Editor. Use the Simulator in either the Design View or Command Editor to test the program at the remote station (see *Simulator* sections in the online manual for either the Design View or Command Editor for more information).

Setting the Event Order

Elements of a marking design should be marked in the most logical sequence for the most efficient production time. Production time is slowed when the laser makes frequent stops and starts and jumps back and forth across the marking field.

The Cycle Time function enables the user to time entire programs, or sections of programs, in hundredths of seconds. By testing cycle times the user can arrange the program event order to achieve the fastest execution time possible.

Setting Process Parameters

In most cases, CLC technicians have determined the optimum process parameters for your specific type of mark(s) before shipping the system. The following information is provided to understand how process parameters are determined and modified should your needs change after the initial purchase or if the user needs to develop his/her own marking applications.

The ProWriter™ F20 provides the user with the following user-adjustable means of controlling the characteristics of the laser mark:

- Marking Speed
- Laser Output Power
- Q-switch (pulse) Frequency
- Galvanometer Settling Time (GST)
- Duty Cycle
- Q-Sync
- Skip Speed

By adjusting these parameters, the user can achieve the desired mark on a specific material. Use the LMS programming commands to adjust the process parameters in the Command Editor.

LMS comes with set default values for process parameters. If values for one or more of the parameters in the program are not specified the default settings are automatically applied when the program is marked. For more information about default settings see the online manual or *Viewing and Editing Default Settings* in Chapter 5, *Software Setup*.

Note: The preset or default values should only be used as a guide and only be adjusted based on the user's marking needs.

Marking Speed

In laser marking, the marking speed is an important variable in the thermal process and must be set to achieve the desired process results. The marking speed is measured in either inches or millimeters per minute depending on the unit of measurement specified in the program.

For deep marking, each point on the engraved line requires more pulses than shallow marking. Beam speed must be reduced until the required depth is achieved. For shallow marking, the speed may be significantly increased.

Note: When changing the marking speed also reset the galvanometer settling time (GST).

Power

The output power of the laser is adjusted by increasing or decreasing the electric current to the fiber. As the current changes, light output from the fiber and the intensity of laser amplification increases or decreases accordingly.

Using the Standard CURRENT Command

The CURRENT command specifies how much power is applied to the fiber under nominal conditions.

WARNING

Do not attempt to exceed the laser's maximum current value.

Q-Switched Frequency

The laser beam is emitted in Q-switched (pulsed) mode. When writing programs in the Command Editor use the QSMODE command.

Galvanometer Settling Time (GST)

Galvanometer Settling Time (GST) is a laser beam delay measured in microseconds that synchronizes the laser beam with the galvanometers' movement during stops, starts, and corners. GSTs can prevent irregularities such as burn holes and gaps at corners.

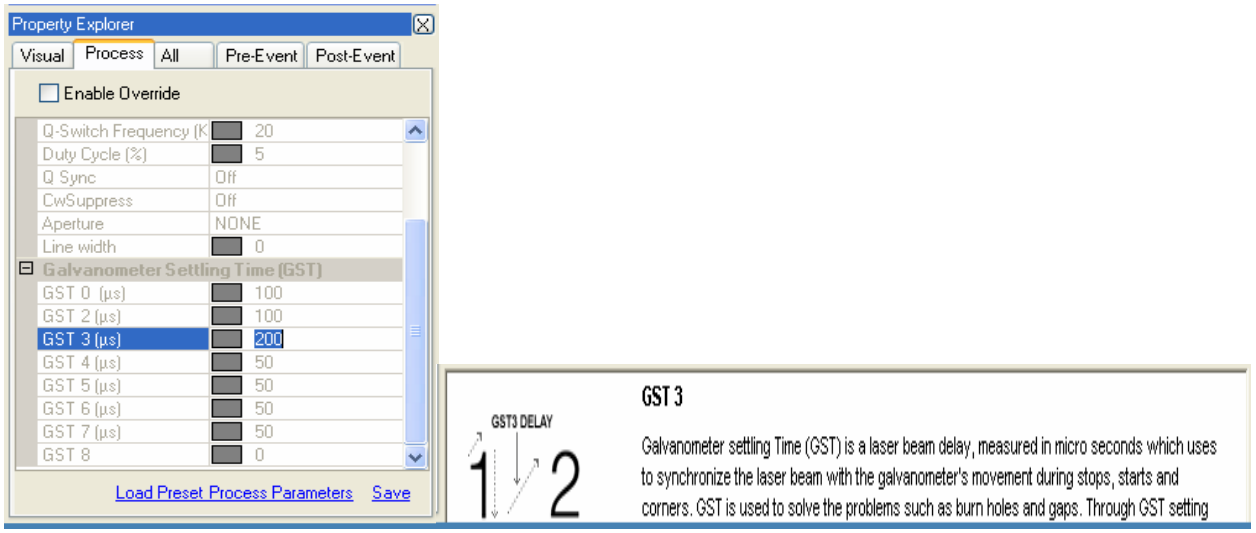
Every SPEED command in a program requires the GST command and its values be placed **after** it. The faster the marking speed, the larger the GST value must be.

CAUTION

Clicking on Reset deletes any changes made to the Laser Default Parameters window.

GST parameter settings define both the type of beam movement where the delays must occur and the length of the beam delays. There are eight types of GST values that control marking quality.

In the Design View, GST settings are edited by clicking on the GST number. This is located in the **Process** tab of the **Properties Explorer**.



Double-click on the GST value field to highlight the current value, enter the new value, and press **<Enter>**. Use the **Properties Help Window** located to the right of the **Properties Explorer** for help on the clicked item.

GST values can also be changed in the Command Editor by typing in the GST number followed its value (syntax: GST #, value).

Setting the correct GST parameters requires some trial and error. See the GST command in the online manual for a list of GSTs and general tips regarding GST adjustment.

Other Parameters

Duty Cycle – not applicable

Q Sync - not applicable

Skip Speed - programmable moving velocity for long moves. Reduces cycle time.

Marking Tips

When setting process parameters consider the type of mark to be made and the material being marked.

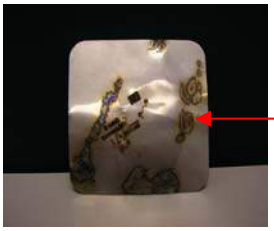
Types of Marks

Depending on the material, a contrasting mark can be created using any one of three different techniques. Each method is differentiated by the maximum temperature achieved on the material's surface.

- **Surface Annealing** - Annealing creates a contrasting mark with very shallow material penetration. The material surface is not disrupted and no engraving occurs. The beam speed must be relatively slow because heat must be conducted into the material. To avoid vaporizing the surface material, the power must be relatively low and the Q-switch value relatively high.
- **Surface Melting** - The material is heated to a molten state and is most frequently used on plastics to induce a color change. This method is typically used to mark plastics with relatively fast speed and shallow marking depth. High speed combined with relatively low power and Q-switch rates creates this effect.
- **Material Vaporization (Engraving)** - Vaporization removes material. This technique has the advantage of considerable speed. Material is almost instantly vaporized with each pulse. Vaporization can also be used to create a contrasting-color effect by removing the top layer of a material coated with two contrasting colors. Relatively high speed and power settings combined with relatively low Q-switch settings create this effect.

Material Characteristics

- **Reflectivity** - Polished metals such as gold and brass require more power to mark due to the highly reflective surfaces. Organic materials such as wood and paper are almost transparent and are not good marking material.
- **Absorption / Temperature Curve** - Changes in temperature of a material varies with the percentage of heat absorbed. Some materials may not be markable because the laser increases the material's surface temperature causing distortion of the material. For example, some plastics exhibit too high an increase in absorption to create an acceptable mark.



Example of distortion of a material

- **Thermal Conductivity** - Highly conductive materials convey heat away from the point at which the laser is attempting to mark. The laser parameters need to compensate for the material's attempt to "heat sink" itself. Aluminum is a good example of a material that requires higher power and/or slower marking speed to achieve acceptable marking results.

- **Color** - Dark-colored materials absorb more laser light than light-colored materials.

Other Marking Tips

- **To achieve the deepest material penetration, use high power, low Q-switch frequency, and low marking speed.**

- **To achieve a surface mark with shallow penetration and increased machine throughput, use low power, high Q-switch frequency, and high marking speed.**

- **At any given power setting, a slow pulse rate vaporizes more material than a high pulse rate. To engrave metals, use a low pulse rate. To anneal metals, use a high pulse rate.**

For a list of common marking materials and their suitability to marking, see Appendix A, *Material Suitability to Laser Marking*.

Program Testing and Debugging

The ProWriter™ F20 provides several ways to test part-marking programs for accuracy. The user can check their marking image results, review the program code line-by-line, or execute the program in real time for debugging purposes.

All testing methods can be performed either at the Marking Laser station or at a remote programming station. At a remote station, the simulator executes the program **exactly** as it would run at a Marking Laser station. The simulator screen displays the marking image, as it would be marked on a part except not in real time.

Testing the Marking Image

Test the appearance of a marking image by either marking the program on a test piece or by running the program on the simulator at the Marking Laser Station

To test the marking image at the Marking Laser station, open and run the program with a part in place (see *Running a Program* on page 6-8 for step-by-step instructions).

CAUTION

Keep the safety shutter switch set to the CLOSE position at all times except when emission outside the laser marking head assembly is desired. Do not open the safety shutter unless all personnel in the laser operating area are wearing laser eyewear with an optical density (OD) greater than 6.0 at 1,064 nm.

If the image does not mark as intended, debug the program using the step or continuous method (see *Testing the Program Code Line-By-Line* on page 6-7).

Testing at a Remote Station

Use the simulator to test the marking image at a remote station. The simulator "marks" the image on the marking screen in the same size, orientation, and event order it would be marked by the laser. It also "runs" the program exactly as it would run at the Marking Laser station, displaying screen prompts and waiting for keyboard input if the program requires.

To test the marking image using the simulator, see the *Simulator* sections in the online manual for either the Design View or Command Editor.

Note: If the optional user-programmable Input/Output module accessory is installed and the program being tested requires interaction with the module, see *Testing with the I/O Module Accessory* below.

Testing with the I/O Module Accessory

If the optional user-programmable I/O module accessory is installed, use the Input and Output Bit icons to simulate set and clear bits. Click on a Bit icon to change the state of the bit: red for set, green for clear.

For example, to test the following program, click on the Bit seven icon so it displays green, simulating a clear bit – in this case, an open door. Load the program to the simulator. The program should not mark the text until you click on the Bit seven icon so it displays red (simulating a set bit, or a closed door).

Example

```
CURRENT 10                  ! Current output: 10 amps
SPEED 10                    ! Speed: 10" per second
QSMODE 5                    ! Q-switch frequency: 5 kHz
POSABS 0,0                  ! Identify absolute XY coordinate
INCH                        ! Measure all units in inches
HEIGHT .25                  ! Mark all subsequent text .25" high
                            ! Do not mark if door is open
:TEST_DOOR_SWITCH           ! Establish label
TSTBIT 7                    ! Test state of bit 7
BRANCHNE TEST_DOOR_SWITCH   ! If door is open, return to label
"Mark this text"            ! If door is shut, mark text
HALT                        ! Stop execution of program
```

Testing the Program Code Line-By-Line

Line-by-line testing of a program's code is referred to as *step debugging*. In step debugging, the user controls the pace of the review and determines which errors, if any, exist in the program.

When using the Marking Laser station, the user must load the program to step debug it. The user may choose to mark during the debugging process or he/she can turn the safety shutter switch to the Close position to prevent marking.

To mark during the debugging process, CLC recommends a PRINT and a PAUSE statement be added after each process is completed. The user would then know if a process was completed (such as drawing a circle) by looking in the User Text and Bitmaps column on the Action Menu during simulation/debugging. Please note when the Action Menu pops up, the user must click on "Lase".

A sample program:

```
INCH                        ! Circle will be drawn in inches
PR -1.971, 0.7              ! Center coordinates of circle: X = -1.971, Y = 0.7
#CIRCLE 0.354               ! Radius of circle is 0.354 inches
PRINT 1,1 "Printed Circle"  ! Print "Printed Circle" after circle is drawn
PAUSE                       ! Pause program
```

CAUTION

Never operate the laser without first reading Chapter 1, *Safety*. Always follow the safety precautions prescribed in the Safety chapter when operating the Marking Laser System.

Part Positioning

The ProWriter™ F20 is equipped with an internal visible diode alignment laser (ViDAL) operating at 660 nm. This eye-visible beam can be used for part location or to visibly trace the marking program. The red beam may be safely viewed through the window of the workstation or viewed through the open door. The operator does not need to wear laser safe eyewear when the diode pointer is used in this manner.

The DRYRUN command is used at the beginning of a part-positioning program to turn on the dry run laser diode. Part-positioning programs should be designed to "mark" a pattern in a loop to produce a constant, visible guide. The loop can be limited to a set number of repetitions or it can be continuous.

See the DRYRUN command in *Section 6.3.1 - CMD Commands* in the online manual for an example of a part-positioning program with a continuous loop.

Running a Program

To enter Laser mode, choose **Laser > Modes > Laser** from the Main menu. **Laser** will be checked. This can be done either in the Run Time, Design View, or Command Editor.

Marking Requirements

In order for the laser to mark a running program the following conditions must be met on the laser console:

- The laser keyswitch must be in the **Power On** position.
- The safety shutter switch must be in the **Open** position.

CAUTION

Never operate the laser without first reading Chapter 1, *Safety*. Always follow the safety precautions prescribed in the Safety chapter when operating the laser.

Lasing a File

A **.lms** file is run from the Design View and a **.cmd** file is run from the Command Editor. The instructions below can be done using both screens and the Run Time unless otherwise noted.

Open file:

a. Choose **File > Open** from the Main menu or press **<Ctrl> + <O>**.
b. Click on the file to be opened.

For the **Run Time**, click on the down arrow next to **Marking Job** and click on the file to be opened.

Run file:

Choose **Job > Start** from the Main menu, press **<F9>**, or click on  in the top toolbar.

Another option (**Run Time** only): Click on 

under Marking Job.

Stop file:

Choose **Job > Stop** from the Main menu, press **<F10>**, or click on  in the top toolbar.

Another option (**Run Time** only): Click on 

under Marking Job.

Pause file:

Choose **Job > Pause** from the Main menu or click on  in the toolbar.

Another option (**Run Time** only): Click on 

under Marking Job.

Software Commands 7

The online manual contains detailed descriptions for creating and editing lasing programs using the Design View and Command Editor.

The following is a quick reference guide for commands. This includes the type of command, its abbreviation or shortened version (if applicable), and a brief description. Please refer to the online manual for a further description and an example.

Command Quick – Reference Guide

Communications Commands

"!" Command	**!**	Enables comments to be added to a program
CLRBIT	**CB**	Clears (turns on) an I/O bit (requires the accessory I/O board)
CLRSCR	**CLS**	Clears information from system's video display
FLUSH	***N/A***	Clears or empties data from serial port
INPUT	**IN**	Enables keyboard input to be assigned directly to a variable
ISDIGIT	***N/A***	Checks to see if byte # is digit
KEYBOARD	***N/A***	Specifies a period of time to wait for keyboard input from the operator
LANIN	***N/A***	Receives UDP data packets from LAN port 1071
LANOUT	***N/A***	This command is for messaging and cycle time initiation. Sends UDP data packets from LAN port 1072 of the TCP/IP stack.
NETIN	***N/A***	Receives data down the network cable and assigns it to text buffer N
NETOUT	***N/A***	Sends data through the network cable
PRINT	**PRT**	Prints information on the system's video display
READBITS	***N/A***	Reads the state of the eight input bits on the accessory I/O board
SERIN	**SI**	Accepts serial data from any device attached to serial port 2
SERINB2AH	**SIH**	Serial in hex information to text buffer

SERINOUTAH2B	**SOH**	Serial out hex information
SEROUT	**SO**	Allows the system to transmit serial data to any device attached to the serial ports
SERPARMS	**N/A**	Controls the setting up of serial ports # 1, 2, 3 and 4
SETBIT	**SB**	Sets (turns off) an I/O bit (requires the accessory I/O board)
TSTBIT	**TB**	Tests the state of an I/O bit (requires the accessory I/O board)
WRITEBITS	**N/A**	Writes the state of the eight input bits on the accessory I/O board

Marking Characteristics Commands

CURRENT	***N/A***	Specifies the amount of current to apply to the lamp
CWMODE	**CW**	Specifies continuous wave (non-pulsed) beam
CWSUPPRESS	***N/A***	Prevents excessive heat conduction from the first pulse
GST	***N/A***	Prevents marking irregularities, such as gaps at corners
LINEWIDTH	**W**	Marks line wider than the beam
POWER	**PWR**	Specifies required power output
QSMODE	**Q**	Specifies beam pulse rate
SLANTF	***N/A***	Slants font
SPEED	**S**	Specifies marking speed
SPIRAL	**SP**	Oscillates marking beam to create wider line widths

Marking Image Commands

"...text..."	***N/A***	Marks text within quotes
#BOX	***N/A***	Provides easy method of drawing a box
#CIRCLE	***N/A***	Provides easy method of drawing a circle
ADDBITMAP	**ADBMP**	Adds bitmap graphic to hot screen
ALTCHARS	**AC**	References alternative character set
ARC	**A**	Marks an arc
ARCCCW	**ACCW**	Lase subsequent arcs **counterclockwise**

ARCCW	**ACW**	Lase subsequent arcs **clockwise**
BARCODE	***N/A***	Lase a barcode or matrix in the marking field
DATE	***N/A***	Assigns current date and time information to variables T500 though T505, 507, and 508
DELALLBITMAPS	**DABMP**	Deletes all user bitmaps
DELBITMAP	**DBMP**	Deletes a bitmap graphic from a hot screen
DRAW	**DW**	Marks a line
EXPIRATIONDATE	**EXPIRE**	Assigns current date and time to variables T500 through T503
LOGO	**L**	References graphic or logo
MOVE	**MOV**	Moves beam without marking an image
NEWDATE	**ND**	Assigns year, day, month and hours to text buffers T500 through T503
STDCHARS	**SC**	References standard character set
VERSION	***N/A***	Marks software version number and date

Mathematical Commands

ADD	***N/A***	Performs the addition operation
COS	***N/A***	Calculates radian value for **cosine** of angle
DIVIDE	**DIV**	Divides value of one variable by value of another
HEXINC	**HEX**	Hexadecimal incrimination
INCREMENT	**INC**	Adds to the value of a variable by a defined **integer** value
INCREMENTD	**INCD**	Adds to the value of a variable by a defined **decimal** value
MASKINC	***N/A***	Increments to next alphanumeric value
MULTIPLY	**MUL**	Multiplies two numeric values (values may be assigned to variables)
SIN	***N/A***	Calculates radian value for **sine** of angle
SUBTRACT	**SUB**	Subtracts value of one variable from value of another
TAN	***N/A***	Calculates radian value for **tangent** of angle

Position and Dimension Commands

ALIGNRUN	***N/A***	Uses the laser diode to verify part/marking image alignment
ANGLE	**AO**	Writes all text at an angle
CENTERED	**JC**	Centers text
DIR	***N/A***	Writes text at one of four 90 degree angles
DRYRUN	***N/A***	Marks a .cmd program using the dry run laser diode instead of the laser beam
HEIGHT	**H**	Defines the marking height of characters and logos
HORIZONTAL	**HZ**	Writes text horizontally
INCH	***N/A***	Specifies measurement system in **inches**
LEFT	**JL**	Left-justifies text
LINE	***N/A***	Writes all text in straight lines
MARKCCW	**<<**	Marks in a ring, **counterclockwise**
MARKCENTER	**M**	Marks in a ring, **centered**
MARKCW	**>>**	Marks in a ring, **clockwise**
METRIC	***N/A***	Specifies measurement system in **millimeters**
MILLS	***N/A***	Specifies measurement system in **mils**
MIRROR	**MI**	Marks all text or logos in mirror image
NORMAL	**NOR**	Nullifies MIRROR command
POSABS	**PA**	Defines absolute coordinates of the marking position and the center of the circle in Ring mode
POSREL	**PR**	Defines position relative to position absolute
RADIUS	**R**	Defines the radius of a circle for Ring mode writing
REALEND	***N/A***	Specifies subsequent logos be interpreted in non-scalable (“real”) heights
REALMODE	***N/A***	Enables all fonts and logos be interpreted in non-scalable (“real”) heights
REALSTART	***N/A***	Starts a block of included files in which the first file determines the scaling factor for subsequently included files

RIGHT	**JR**	Right-justifies text
RING	***N/A***	Writes all text in circles
SCALEX	**CX**	Scales text and logos in the X-axis
SCALEY	**CY**	Scales's text and logos in the Y-axis
VERTICAL	**VE**	Writes all text vertically

Program Control Commands

":" Command	**:**	Establishes a label (name) for a branch destination
"/" Command	***/***	Executes a command only once after the file loads, then ignores it
#INSERT	***N/A***	Merges contents of one file with another file at compile time
ABORT	**AB**	Terminates the execution of a command file
AUTOSTART	***N/A***	Starts program immediately after loading
BITF	**BF**	Allows I/O bits to come on when fault conditions occur during the lasing process (requires the accessory I/O board)
BRANCH	**BR**	Transfers control to a label
BRANCHE	**BEQ**	Branches if **equal** to a condition
BRANCHG	**BRG**	Branches if **greater** than a condition
BRANCHL	**BRL**	Branches if **less** than a condition
BRANCHNE	**BNE**	Branches if **not equal** to a condition
BRANCHNZ	**BNZ**	Branches if **equal** to a condition
BRANCHZ	**BRZ**	Branches if **not equal** to a condition
CALL	***N/A***	Starts another command program
COMPARE	**CMP**	Compares the value of a variable with either the value of another variable or a literal text string
COMPAREAH	**CMPH**	Compares a text buffer to a HEX value
ENDLOOP	**EL**	Marks end of program segment to be looped
GOSUB	**GOS**	Transfers control to a sub-program
HALT	***N/A***	Terminates the command file but does not delete it from the system memory

INCLUDE	***N/A***	Loads command, text and logo files, as well as character sets (fonts), to be referenced by subsequent command files
LOADRUN	***N/A***	Loads cbn version of a .cmd file previously loaded to the rear computer through auto.cbn
LOOP	**LP**	Directs the system to repeat a sequence of commands
PAUSE	**PS**	Suspends program execution until a start-write signal is given
RETURN	**RET**	Returns execution of a program
RUN	***N/A***	Runs a DOS command line statement from the rear computer
TSTFAULTS	**TF**	Sets branch flag to true if faults occur and check faults are on
TSTPOWER	**TP**	Sets branch flag to true if power does not reach level as programmed
TSTSHUTTER	**TS**	Sets branch flag to true if shutter is closed during lasing process
TSTWARNINGS	***N/A***	Sets branch flag to true if warnings occur and check faults are on
WAIT	***WT***	Delays program by a specified length of time

Text/Variable/File Commands

ACLOSE	***N/A***	Closes a text file that has been opened for appending by AOPEN
AOPEN	***N/A***	Opens a file for appending
APPEND	***N/A***	Writes a line of text to end of a file
ASSIGN	**ASN**	Assigns text or values to a variable
BFSIZE	**BS**	Assigns the file size of a binary file to a variable
BRCLOSE	**BRC**	Closes binary read file
BREAD	***N/A***	Reads binary number of bytes data from a file
BROPEN	**BRO**	Opens binary file for reading
BRSEEK	**BRS**	Positions number of bytes into binary file for reading
BWCLOSE	**BWC**	Closes binary file for writing
BWOPEN	**BWO**	Opens binary file for writing

BWRITE	**BW**	Writes number of bytes to a binary file
BWSEEK	**BWS**	Positions number of bytes into binary file for writing
CYCLETIME	**TIME**	Saves the time (in milliseconds) in text buffer
DEF	***N/A***	Defines variables within text files, logos within logo files, characters within fonts, and command sections within command files
LENS	***N/A***	Assigns the laser's XY millimeter scale value to variable 508
RCLOSE	***N/A***	Closes the text file previously opened for reading by the ROPEN command
READ	***N/A***	Reads data from an open text file and assigns it to a variable
ROPEN	***N/A***	Opens a text file on the rear computer for reading
STRIPPER	**STRIP**	Strips space characters from the left or right
TCAT	***N/A***	Adds one text string to another
TLEFT	***N/A***	Copies text from the left of a specified location in a source string and assigns it to a destination variable
TLEN	***N/A***	Determines the number of characters in a string and assigns the number to a variable
TMID	***N/A***	Extracts text from the middle of a string
TRIGHT	***N/A***	Copies specified number of characters from the end of the source string to the destination text buffer
WCLOSE	***N/A***	Closes text file previously opened for writing
WOPEN	***N/A***	Opens a text file on the rear computer for writing
WRITE	***N/A***	Writes data from a variable to an opened text file

Routine Maintenance 8

Performing Inspection and Maintenance

Only individuals who have read the safety chapter of this manual should perform routine inspection, maintenance, troubleshooting, and repairs. Proper safety precautions should always be followed when operating, inspecting, and repairing the laser. A qualified technician should perform all troubleshooting and repairs requiring specific electrical knowledge.

Contact Field Service for technical assistance, information on ordering parts, ordering maintenance tool kits, and where to send parts for repair.

Recommended Maintenance Schedule

Control Laser Corporation (CLC) recommends an established routine maintenance schedule be followed. Performing the following simple inspection and cleaning procedures on a regular basis helps ensure optimal laser performance:

- Check the laser power output at the workpiece. (See *Testing Power Output* below for a test program)
- If a drop in laser power output is detected, inspect the scan mirrors and optics and clean as necessary. (See *Optics Maintenance* pg. 8-3 for cleaning instructions)

The frequency of inspection and cleaning depends on the cleanliness of the worksite environment, power level of the laser, and the material being marked. Evaluate the level of airborne and surface contaminants in the laser's environment and follow the appropriate maintenance guidelines in the following chart. Monitor the laser's performance over time and adjust the maintenance schedule as required.

	Inspection and Cleaning Schedule	
If using:	**Low Power (< 15 watts)**	**High Power (> 15 watts)**
Dirty Environment:	15 - 30 Days	7 Days
Clean Environment:	90 Days	15 - 30 Days

Testing Power Output

Test the laser's power output to confirm that the laser is emitting the required level of power. A drop in power output over time indicates dirty or damaged optics or it might be a sign of a more serious problem.

To test the power output, hold a laser power probe in the beam's path while running the *Power Output Test Program*. The program should be created in the Command Editor and

saved with the .cmd extension. (See Appendix B, *Part Numbers*, for laser power probe ordering information and information on the Maintenance tool kit.)

Power Output Test Program

```
AUTOSTART
SETBIT 39
CLRSCR
PRINT 9,10 "Set current to 18 amps."
PRINT 10,10 "Place power probe in beam path and press"
PRINT 11,10 "ENTER to turn on the beam for test"
INPUT 6
PRINT 10,10
PRINT 11,10
CURRENT 18
WAIT 500
Q 21
CLRBIT 39
PRINT 10,10 "The beam is on"
PRINT 11, 10 "Press ENTER to turn the beam off"
INPUT 99
SETBIT 39
CLRSCR
PRINT 10,10 "The beam is off"
PRINT 11,10
```

Before You Begin

- Put on laser safety goggles with an optical density (OD) as recommended on page 1-.
- Turn the keyswitch to the Power On position

WARNING

Do not open the safety shutter unless all personnel in the operating area are wearing laser eyewear with an optical density (OD) as recommended on page 1-1.

To test laser power output:

1. In Laser Marking Studio™ (LMS), click on the **Status** tab to view the Status window.
2. Choose **File > Open** from the Main menu. The Open dialog box is displayed.
3. In the **File Name** field, enter the name of the laser output test program. Click on **OK**. The file is automatically loaded.
4. Hold the laser power probe underneath the scanner head where the laser beam is emitted. **Do not place the probe on the marking surface where the beam is focused as this will damage the probe.** Instead hold the probe several inches away

from the scanner head and above the marking surface so the unfocused beam touches the probe.

5. In the main menu, either click on **Job**, then **Start**; or press **<F9>**. The program is executed. Follow all onscreen prompts.

6. Take a reading after the power probe has stabilized.

Optics Maintenance

Inspection and cleaning of the ProWriter™ F20 scan mirrors and protective window are necessary only if a drop in laser power output is detected during testing. Inspecting and cleaning the scan mirrors requires opening the scanner head. **It is extremely important the scanner head, which also contains the focusing lens, remain as clean as possible.**

WARNING

Do not open the scanner head and expose the scan mirrors and lens to airborne contaminants unnecessarily, especially if your work environment is heavily contaminated.

Inspecting and Cleaning the Protective Window / Focusing Lens Assembly

The focusing lens and the glass protective window are joined in a single assembly. The protective window prevents the lens from getting dirty. Do not remove the protective window from the lens. As long as the protective window is intact, you should never have to clean the focusing lens.

Equipment and Supplies

- Optical Cleaning Kit from Field Service

Procedure

1. Inspect the focusing lens and protective window by looking down through the open scanner assembly. Do not unscrew the lens assembly.

2. Remove dust, dirt, or other contaminants from the inner surface of the protective window with low-pressure, clean, dry compressed air or nitrogen, or brush the glass lightly with a dry camel-hair optical brush.

3. Carefully replace the top scanner head cover and tighten the screws.

   If the protective window appeared **dirty** during inspection, go to **Step 4**.

   If the protective window appeared **clean** during inspection, the procedure is **complete**.

4. Use a #8 flat head screwdriver to unscrew the quarter inch turn screws in the bottom plate of the scanner head.

5. Carefully unscrew the lens assembly from the scanner assembly.

6. Remove dust, dirt, or other contaminants from the outer surface of the protective window with low-pressure, clean, dry compressed air or nitrogen, or brush the glass lightly with a dry camel-hair optical brush.

   If further cleaning is necessary, go to Step 7; otherwise, the procedure is complete.

7. Dip a clean, cotton-tipped swab or lens tissue in HPLC-grade acetone or Reagent-grade methanol (residue after evaporation: 1 ppm).

WARNING

Both acetone and methanol are highly flammable. Use extreme caution when using acetone or methanol to clean laser components.

A fire or explosion could occur if the laser beam is allowed to contact flammable or combustible materials. Keep acetone and any other flammable or combustible materials away from the laser when the keyswitch is in the POWER ON position.

8. Shake excess liquid from the swab. Gently roll the moist swab across the glass allowing each side of the swab to touch the surface only once. Discard the swab and repeat with a new swab. Continue until the entire glass is clean.

   Do **not** touch the surface with a dirty swab; this re-contaminates it. Do **not** dip used swabs in the cleaning solution; this contaminates the solution.

   Use gentle pressure to remove dirt and oils. Do **not** rub a dry swab against a dry surface or scratching might result.

   - Or -

   Gently rub the wet lens tissue across the glass in a circular motion starting from the center of the glass and working slowly to the outer edges. Do **not** stop after the circular motion is started or a haze will form.

   Use a clean section of lens tissue for each stroke across the glass. Use gentle pressure to remove dirt and oils. Do **not** rub dry tissue against a dry surface or scratching might result.

9. Inspect the protective window for foreign material, burn marks, and other damage.

   The best way to inspect the protective window is to hold it flat at eye level and look across the surface. Using a magnifying glass while looking directly at the window also makes damage easier to see.

10. If the protective window is **not** damaged, attach the lens assembly back into the bottom of the scanner assembly.

    - Or -

    If the window appears damaged, contact Field Service for assistance.

Fuses

The ProWriter™ F20 has five fuses attached to the control unit (bottom) that should be replaced annually. There are four fuses in the rear of the unit and one in the front. See *Figure 8-1a* and *Figure 8-1b* for details on the placement and power of the fuses.

Figure 8-1a. Front of Control Unit (Bottom)

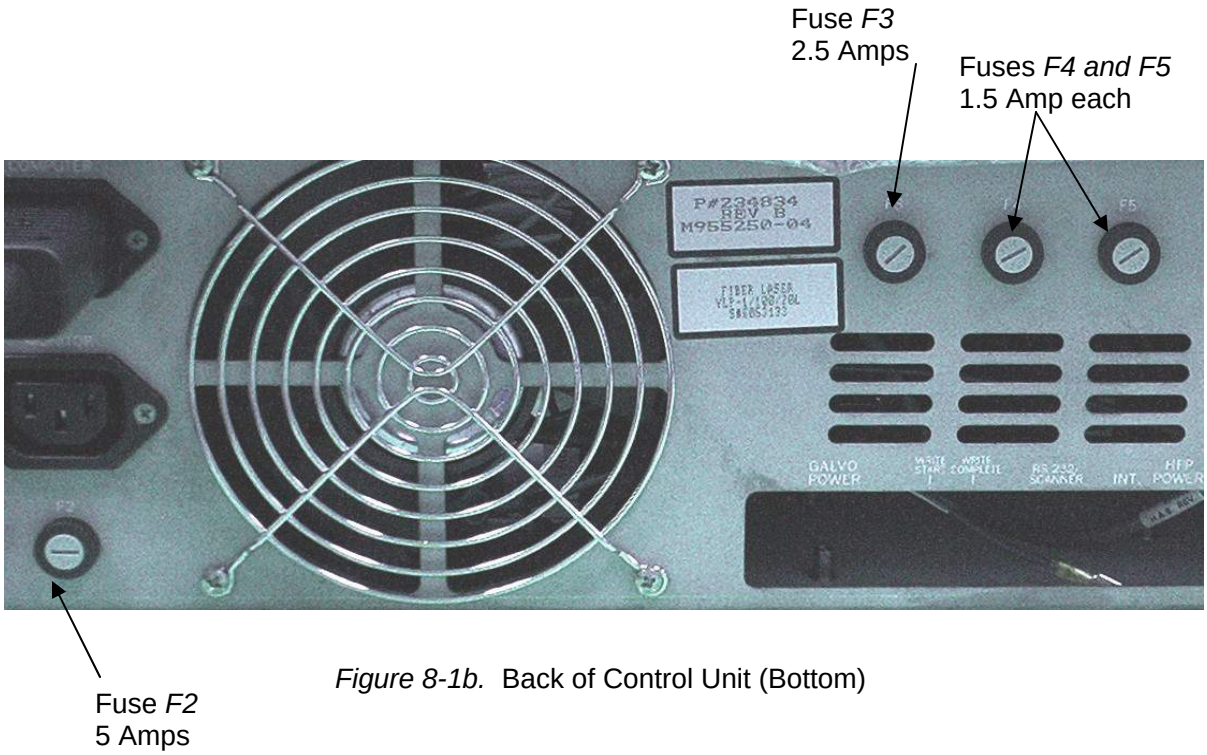
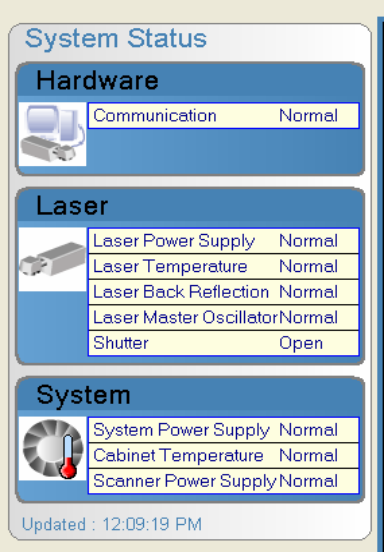


Figure 8-1b. Back of Control Unit (Bottom)

Troubleshooting 9

Overview



This chapter provides guidelines for troubleshooting the laser status indicators located in the System Status window on the computer screen (*see left)*.

The System Status indicators identify the current state of the following functions vital to laser system operation:

- Communication
- Laser Power Supply
- Laser Temperature
- Shutter
- System Power Supply

When a function deteriorates, the blue outline surrounding the status box changes to **yellow** and the "Normal" status changes to the appropriate indicator. This state is referred to as the **warning** state.

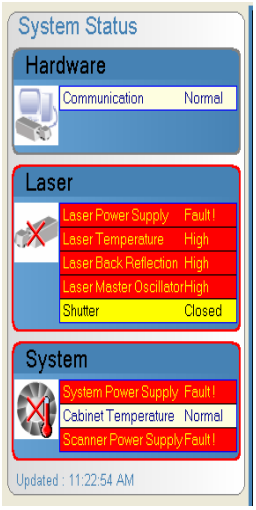
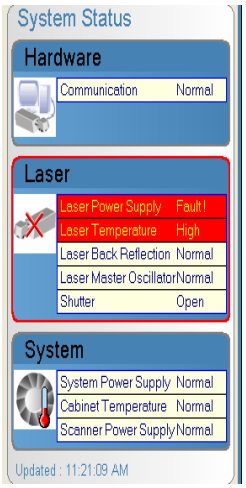
When a function has failed, the blue outline surrounding the status box changes to **red** and its indicator changes from "Normal" to "Error". This state is referred to as the **fault** state and the laser will not operate.

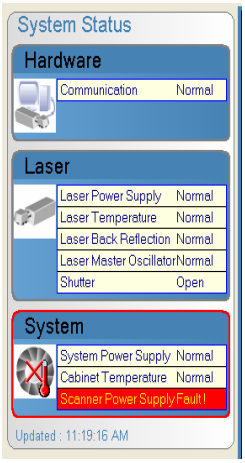
Warning and fault states may lead to operational difficulties, damage to the system, or automatic system shutdown. Monitor the status indicators on a regular basis.

The troubleshooting procedures in this section are intended as guidelines only. For step-by-step instructions on how to access, inspect and replace components, refer to the appropriate sections in Chapter 8, *Routine Maintenance*.

WARNING

A qualified maintenance person should perform all troubleshooting procedures. Read the Safety and Routine Maintenance chapters of this manual before performing any troubleshooting procedures. Follow all safety precautions described in the Routine Maintenance chapter's step-by-step procedures.

Fault	Potential Cause	Action
General System Failure	E-Stop Depressed	Reset E-Stop to Run Position and Restart System
	Loose Connection	Turn Laser Off. Check All Cables & Connectors Running From Computer to Laser Case
	Fuse Blown	Turn Laser Off. Inspect Fuse 1. Replace If Necessary
	Laser Power Supply Malfunction	Contact CLC Field Service
Laser Will Not Lase	Fuse Blown	Turn Laser Off. Inspect Fuse 3. Replace If Necessary
	Loose Connection	Turn Laser Off. Check All Cables & Connectors Running From Computer to Laser Case
	Laser Power Supply Malfunction	Contact CLC Field Service

Scanner Not Operating 	Fuse Blown	Turn Laser Off. Inspect Fuse 4 and 5. Replace If Necessary
	Loose Connection	Turn Laser Off. Check All Cables & Connectors Running From Computer to Laser Case
	Scanner Power Supply Malfunction	Contact CLC Field Service
Computer Will Not Start	Loose Connection	Turn Laser Off. Check Power Cable From Wall Outlet Into Computer
	Fuse Blown	Turn Laser Off. Inspect Fuse 2. Replace If Necessary
	Key Not Set to "Computer On' Position	Turn Key to Computer On Position
	Computer Power Supply Malfunction	Contact CLC Field Service

Material Suitability for Laser Marking

Material	Image Contrast
Carbon Resin	Good
Ceramics	
Bare	Good
Gold plated	Good
Lacquer coated	Good
Glass	Poor
Proprietary CLC Process	Good
Inconel Graphite	Good
Kovar (gold plated)	Good
Metallics	
Aluminum	
Anodized	Excellent
Bare	Good
Black oxide coated	Excellent
Brushed	Good
Cast	Good
Galvanized	Good
Painted	Excellent
Brass	
Bare	Good
Coated lacquer	Good
Bronze	Good
Cast Iron	Good
Cobalt	Good
Copper	
Bare	Poor
Nickel coated	Good
Germanium	Good
Gold	Poor
Silver	Good
Steel	
Cadmium coated	Good
Carbon steel	Excellent
Cast steel	Good
Chrome plated	Good
Hardened	Good
Nickel plated	Excellent
Oxide coated	Good
Spring steel	Good

Material	Image Contrast
Metallics Continued	
Stainless (polished)	Excellent
Stainless (unpolished)	Excellent
Steel alloy	Good
Stress-proof steel	Good
Surgical steel	Excellent
Untreated steel	Good
Titanium	Excellent
PC Board	
Bare	Good
Coated fiber	Good
Fiber substrate	Poor
Plastics	
ABS	Excellent
Acrylic	Good
Delrin	Poor
DIP plastic	Good
Epoxy	Excellent
Lexan	Good
Lucite (clear)	Good
Lucite (painted black)	Good
Melamine	Poor
Mylar (w/ silver nitrate coating)	Good
Nylon (w/ glass fill)	Good
Nylon (Zytall)	Good
PES (poly ether-sulfone)	Excellent
Phenolic	Good
Plaskon	Good
Polycarbonate	Excellent
Polyethylene	Good
Polyurethane	Good
PVC	Excellent
Rynite	Good
Ryton	Poor
Styrene	Excellent
Teflon	Poor
Thermal reinforced resin	Good
Valox	Good
Vandar	Good
Rubber	Poor
Wood	Poor

Part Numbers B

Use the part numbers listed when ordering parts and test equipment. Parts and equipment can be purchased individually or in kits. (Quantities refer to kit contents only.)

(For ordering information, see the Technical Support Directory at the beginning of this manual.)

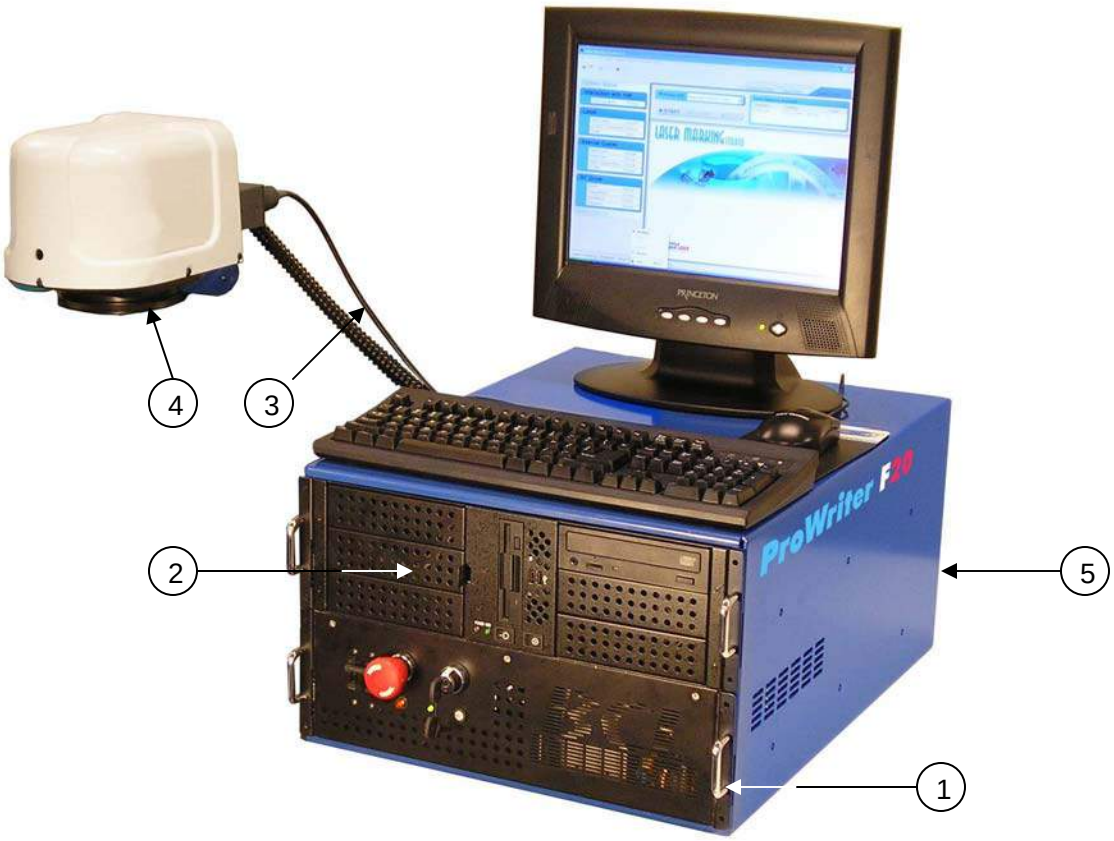
Part Number	Description	Quantity
227380	LED, 6 chip, 585 nm, T1.75, 14 VAC	4
234866	Fuse, 5X20 mm, 1.0 Amp	4
234867	Fuse, 5X20 mm, 1.5 Amp	4
234868	Fuse, 5X20 mm, 2.5 Amp	4
234869	Fuse, 5X20 mm, 5.0 Amp	4
234888	Scanner Kit, 12 mm, 6240	1
234618	Fiber Optic System	1
234834	Assy, Controller	1
234872	Assy, Computer	1
234835	Assy, Power Supply	1

Field Service, Tool Kit # 234899

Part Number	Description	Quantity
234643	Viewer IR Hand Held	1
234648	Safety Glasses Nylon Frame	1
234897	Tool Case, Field Service	1
234908	Power Detector Kit	1
	Detector Power 1,064/ .4mv	
	Coax Cable w/BNC CONN .4’	
	Test Adapter BNC FEMALE/DUAL Banana Jack	

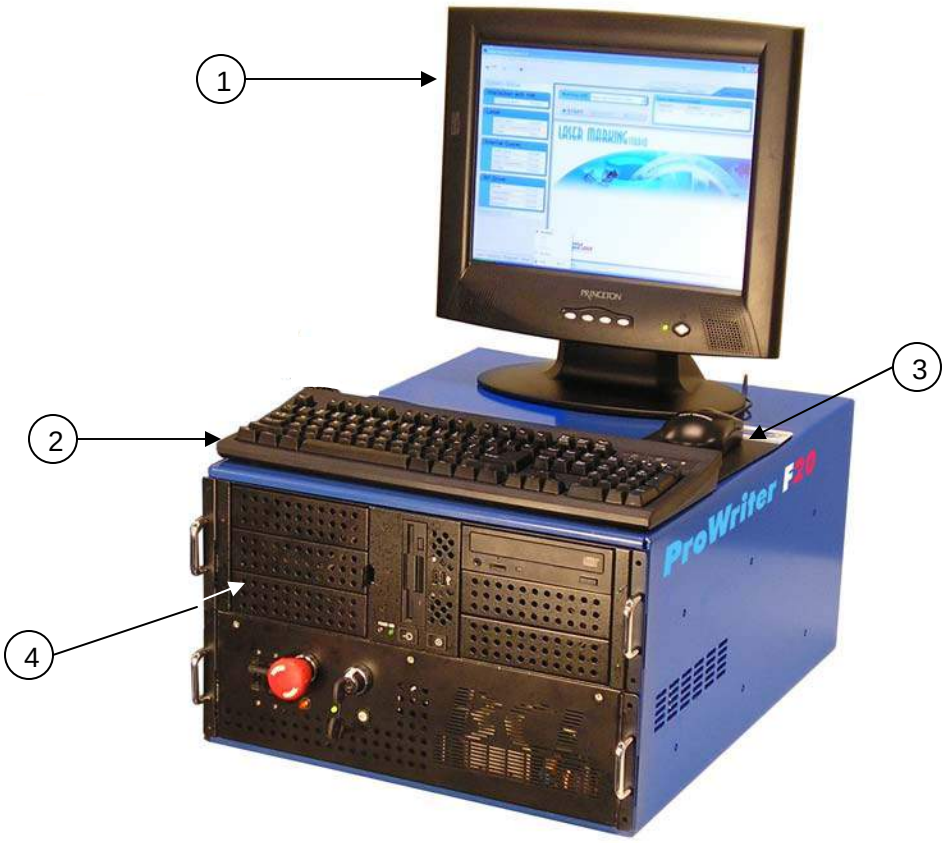
Part Number	Description	Quantity
	Heatsink, Thermopile	
234909	RF Dummy Load Kit	1
	Load Dry RF Dummy	
	Adapter Coax N-FEMALE/MALE-BNC	
	Coax Cable w/BNC CONN .4’	
234910	RF Watt-Meter Kit	1
	CONN. BNC FEMALE	
	Watt/Meter	
	Element 100W	
234911	Water System Test Kit	1
	Meter Water Flow	
	Barb Fitting .1” NPT to ½”	
	Tubing, Nylobraid ½ ID X 1/8 W	
	Clamp. Hose 5/16 – 7/8	

General Assembly



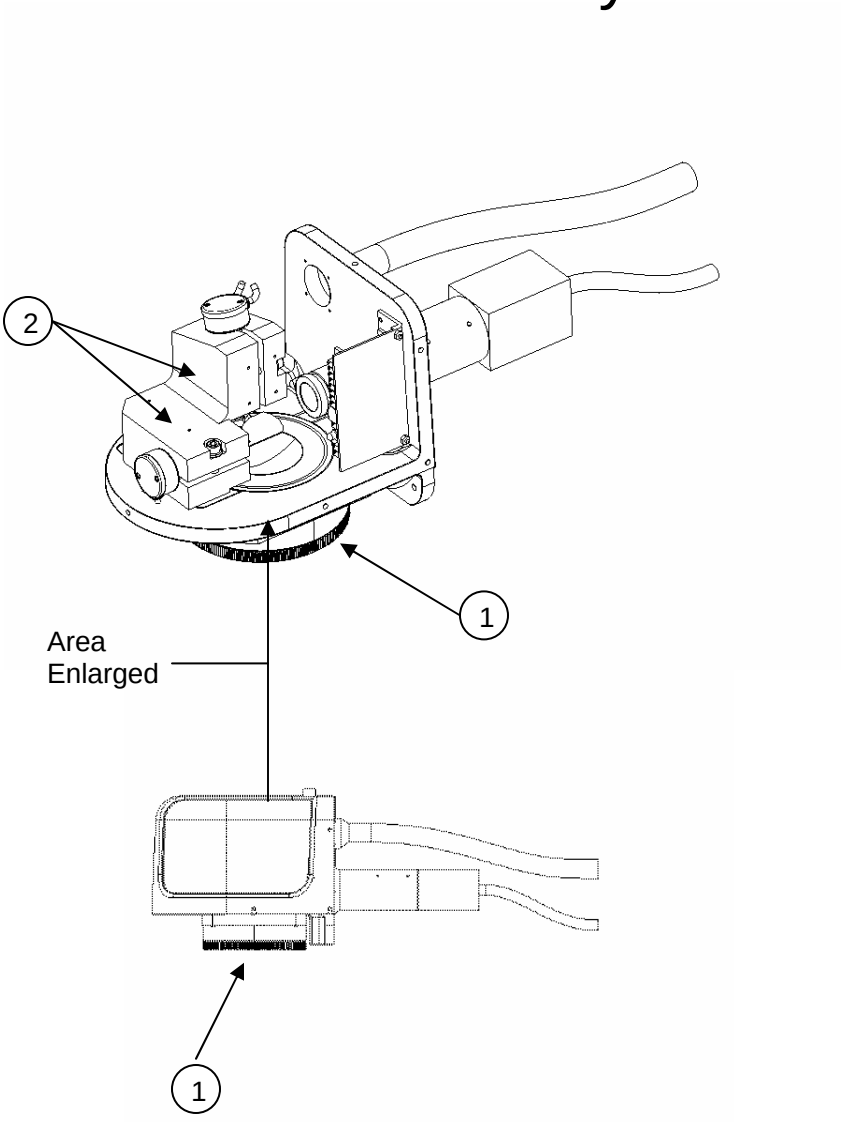
Item #	Description	Part #
1	Assy, Controller	234834
2	Assy, Computer	234872
3	Umbilical	234873
4	Assy, Scan Head	234874
5	Enclosure, Case	234804

Computer Assembly



Item #	Description	Part #
1	Monitor, Flat Panel, 17 in.	234618
2	Keyboard, Charcoal	234894
3	Mouse, Charcoal	234895
4	Assy, Computer	234872
5	PCB Assy, APEX (not shown)	234410

Scanner Assembly



Item #	Description	Part #
1	Assy, Lens, 12 x 12 Flat Field, IR	234988
1	Assy, Lens, 6 x 6 Flat Field, IR	234930
1	Assy, Lens, 4 x 4 Flat Field, IR	235025
2	Scanner Assy, 12 mm 6,240 with XY Mount	234888
3	Cover, Scan head	234796