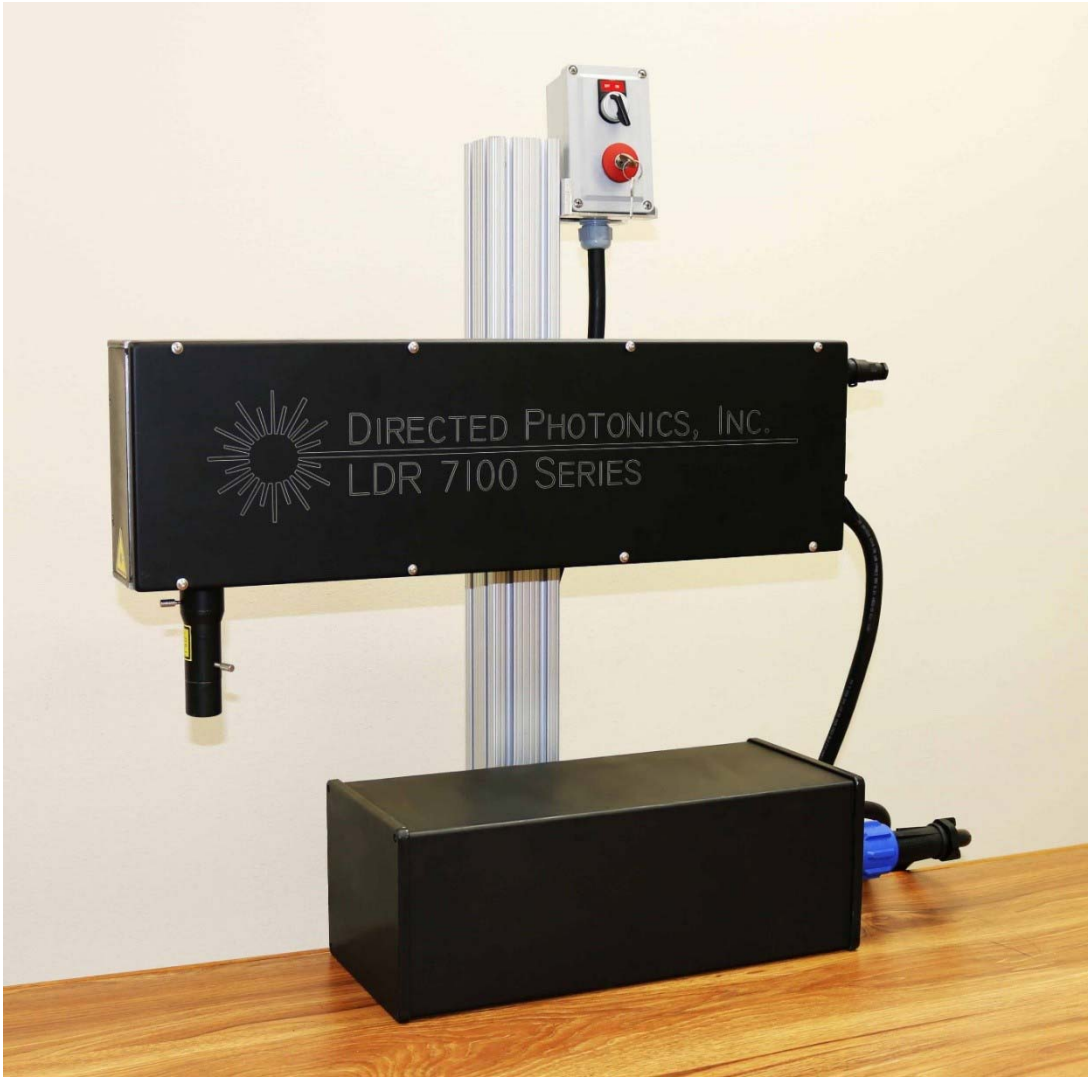
Directed Photonics, Inc
Leaders in CO2 Laser Tube Manufacturing

# *LDR Operator's Manual*
# *Revision 1.6*
# *25 July 2017*




***Directed Photonics, Inc., 15375 Barranca Parkway, Unit H-104, Irvine, CA 92618***
***www.dpilasers.com***

***Contact: robert.marusa@dpilasers.com / Tel/FAX: (800) 580-4073***

# LDR Operator's Manual
## Revision 1.6 / 25 July 2017

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# 1.0 Introduction

This manual contains information required and necessary for the safe operation and maintenance of the laser system. The operation manual is always available online at the DPI website to the LDR system. This operation manual is intended for the trained operation personnel of the laser system. This manual is subject to technical modifications for improvement or technical progress without notice.

**Before operating or servicing the LDR carefully read this manual in its entirety including the Appendices!**

**NOTICE**

The printed operating instructions should be stored near the laser system and be easily accessible to the operator. In case of any questions please contact Directed Photonics, Inc., directly. Do not attempt unfamiliar or undocumented maintenance on the LDR system or control interfaces without first contacting DPI technical support.

If technical assistance is required, please contact DPI at the address and contact numbers listed below:


Directed Photonics, Inc.,
15375 Barranca Parkway, Unit H-104, Irvine, CA 92618
Contact: robert.marusa@dpilasers.com
Tel/FAX: (800) 580-4073
Web Address: www.dpilasers.com

# 2.0 Intended Use

**CAUTION**

The LDR is designed only as an electro-optical component to be installed in a larger continuous production system. It is not designed for residential or light industrial applications. It is designed to be integrated in continuous large scale production operations only such as box, package or bottle manufacture for the marking/coding of production/expiration dates, batch text printing, serial numbers, etc. The user/operator/owner of the LDR is responsible for meeting local, state and federal regulations relating to the safe operation of industrial laser marking equipment including the LDR system!

The laser system must **only be used for the treatment of material surfaces**. The surfaces are locally heated by intensive class 4 laser radiation from multiple laser beams and are thereby thermally modified.

***It is essential that the user understand in detail the functional hardware GUI interface requirements detailed in Appendix A and software controls detailed in Appendix B of this document.***

**DANGER**

**Laser Radiation Hazard!**

- **Never expose human beings or animals to laser radiation!**
  This might result in severe burns of eyes or skin.
- **Never expose flammable materials to laser radiation!**
  Always ensure appropriate shielding of the laser beam! Errors during marking on flammable materials (e.g. paper) might cause fires. Make sure that the laser area is free of explosive materials or vapors! Take suitable safety measures by installing smoke or fire detectors, extinguishers or similar devices!
- **Never expose reflecting surfaces to laser radiation!**
  The reflected laser beam may cause the same dangers - in individual cases even greater dangers - as the original laser beam.
- **Never expose unknown materials to laser radiation!**
  Some materials are easily penetrated by the laser beam, although they seem to be opaque for the human eye. The DPI technical staff can assist with substrate suitability evaluations.
- **Danger of explosion!**
- **Avoid arbitrary modifications or changes to the installed LDR!**
  If a modification made by the Operator to a previously classified laser system leads to a change of its performance data and/or its intended use then a new laser class risk assessment is required.
- **The laser system with open covers and/or with open beam delivery system must be operated by specially trained and qualified personnel only! Make sure that the laser exposure protection rules are always observed!**

# 3.0 Safety Instructions

## *3.1 Laser Safety Classification and Requirements*

The complete LDR system, prior to a proper ultimate installation in the Operator's manufacturing/production system, is classified as class 4 laser system according to EN 60825 (EU standard) and 21 CFR 1040 (US standard). When the beam aperture is completely blocked/surrounded with suitable non-flammable and non-vaporizing laser absorbing material, the laser system acts as a class 1 laser system (the highest safety class for laser exposure). If the beam outlet including the substrates/surfaces to be marked are shielded appropriately then the complete and closed laser system acts as a class 1 laser system and no additional protection is required for safe operation. The shielding is essential in preventing undesired leakage of laser radiation or laser beam reflections out of the desired target area.

**NOTICE**

The shielding is not included in the scope of delivery! The LDR system provides an interlock interface through which the shielding enclosure, when opened, can be detected in the open and unsafe condition which will then cause the LDR marking to become disabled

**CAUTION**

The interlocked laser beam safety shielding must always be closed to external intervention also if there is no product in front of the laser lens!

**DANGER**

Suitable safety goggles provide protection against direct or indirect reflected or diffusely scattered laser radiation. Suitable safety goggles are designed for the wavelength range of the $CO_2$ laser of 9 µm to 11 µm). Most glass and plastic based safety glasses will provide adequate eye safety protection.

**NOTICE**

The standard reference for laser safety is the American Standard for the Safe Use of Lasers, Z136.1-2000, developed by the American National Standards Institute (ANSI). This reference is the basis for many of the federal regulations for laser and laser system manufacturers, and for the Occupational Safety and Health Administration (OSHA) laser safety guidelines. It contains detailed information concerning proper installation and use of laser systems. While the ANSI standard itself does not have the force of law, its recommendations, including warning signage, training, and the designation of a laser safety officer, may be compulsory under local workplace regulations when operating laser systems above Class I. It is the operator's responsibility to ensure that the installation and operation of the DPI LDR Laser System is performed in accordance with all applicable laws. Copies of ANSI Standard Z136.1-2000 are available from:

The Laser Institute of America
12424 Research Parkway, Suite 125
Orlando, FL 32826
(407) 380-1553

## 3.2 Electrical Safety and Standards

**NOTICE**

The User/Operator is solely responsible for the correct and safe electrical installation of the LDR system as a component within a larger production system. There is only a single 15 amp, 3-wire 90-240 VAC input cable harness interface to the external AC power and a series of low voltage (<30 Volts) control I/O connections to the unit as well. Do not operate (unplug from AC voltage) the LDR when the LDR top cover is removed. The electrical specifications for the LDR are given in the “Specifications” chapter.

The following reference standards may apply to the integrated LDR Laser Marking System::

| | |
|---|---|
| 2004/108/EC | EMC Directive |
| 2006/95/EC | Low Voltage Directive |

The LDR Laser Marking System is designed to meet the following reference standards when properly installed/shielded and I/O interfaced:

| | |
|---|---|
| EN 55011:2007 | Electromagnetic Emissions, Class A |
| EN 61000-6-2:2005 | Industrial Electromagnetic Immunity |
| EN 61000-3-2:2006 | Harmonic Current Emissions |
| EN 61000-3-3:1995 Amended 2005 | Voltage Changes and Flicker |
| EN60825-1:2001 | Safety of Laser Products |

## 3.3 Safety Devices and Warning Lights

The complete laser system includes various safety devices and warning lights which can give alarm signals and prevent damage to people and/or equipment. There must be no alterations to safety devices or to the warning lamps!

### *Safety Devices*

**E-Stop/Key-Switch** A combined E-Stop/Key-Switch located on the Control Pendant prevents operation of the laser system by unauthorized people and provides an instantaneous AC power disconnect to the entire LDR system. Make sure that the key is withdrawn during non-use periods and is available to authorized personnel only!

**Arming Switch**

The Control Pendant also contains an Arming Switch which powers the primary DC power supply that then powers the laser modules. The arming switch button will illuminate when in the "On" state.

***Figure 1. LDR Control Pendant with E-Stop/Key-Switch and Arming Switch***

**Interlock**

All safety doors, protective covers, etc. must be safeguarded by interlock devices. The LDR has an interlock input which is described in the Specification chapter of this manual and in the appendices as well.

## *Warning Lights*

The LDR has multiple signal lights located inside the laser head top cover and can be viewed through a sealed window. The signal lights are colored green, amber, red and blue.

A. Green Lamp: In System Idle mode, the on-board green system status LED will blink continuously. In System Ready mode, the on-board green system status LED will be lit continuously.
B. Amber Lamp: In print Enable mode "On", the on-board amber system status LED will turn "On".
C. Red Lamp: The red LED will turn on whenever the lasers are firing. They will also blink for five seconds after print Enable is turned "On" and if the Cold Start mode is turned "On" by the user.
D. Blue Lamp: The blue lamp will blink out dots and dashes representing error codes detected by the LDR system. The codes are as follows:

| Software Fault Code Name | Internal Code | Long Flashes | Short Flashes | Fault Description Text |
|---|---|---|---|---|
| ERR_CODE_FPGA | 0x0101 | 1 | 1 | FPGA mismatch error |
| ERR_CODE_INTERLOCK | 0x0201 | 2 | 1 | Interlock Fault |
| ERR_CODE_KEYSWITCH | 0x0202 | 2 | 2 | Arm Switch Fault |
| ERR_CODE_DC_POWER | 0x0203 | 2 | 3 | DC Power Fault |
| ERR_CODE_LASER_84V | 0x0204 | 2 | 4 | Laser 84V Loss |
| ERR_CODE_LASER_MOD | 0x0205 | 2 | 5 | Laser Modulation |
| ERR_CODE_DUTY_CYC | 0x0206 | 2 | 6 | Duty Cycle |
| ERR_CODE_LASER_RF | 0x0301 | 3 | 1 | Laser RF Fault |
| ERR_CODE_OVER_TEMP | 0x0302 | 3 | 2 | Over Temperature |
| ERR_CODE_VACUUM | 0x0303 | 3 | 3 | Vacuum Error |
| ERR_CODE_COOLANT | 0x0304 | 3 | 4 | Coolant Error |
| ERR_CODE_OVERLAP | 0x0305 | 3 | 5 | Mark Overlap |

***Table 1. LDR Blue Lamp Pulse Format Failure Codes***

When installing the laser make sure that green light (System Idle) blinks when powered up. Note that there are no warning lights on the Power Supply Unit or the Control Pendant. The warning lights are located on the laser head top cover where shown below.


***Figure 2. LDR Warning Lights Window Location***

## 3.4 Safety Information for ZnSe Lenses

**CAUTION**

### Zinc Selenide

The LDR system contains components which are dangerous to health. Zinc selenide (ZnSe) is a toxic compound when inhaled or ingested. Dust may lead to irritation of the eyes and the respiratory system. Do not eat, drink or smoke while handling zinc selenide. Wash hands thoroughly afterwards. The laser focusing lens consists of coated zinc selenide and contains an extremely small amount of the element thorium.

### In case of a broken lens...

Do not inhale material particles. In case of breaking of the laser scan lens please collect the fragments wearing gloves (avoid raising dust when sweeping up the pieces), pack the fragments into a closed plastic bag and send them back to us for disposal

### Maintenance of the Laser Focusing Lens

Information concerning the maintenance of the laser scan lens can be found in the section "Cleaning the Focusing Lens". Please contact DPI if further information is required.

## 3.5 Laser Marking Decomposition Products

**CAUTION**

When treating materials with laser radiation, decomposition products are produced which are dangerous to health. Through vaporization of substrates and coatings, fine dust and vapors are produced which might include hazardous decomposition products depending on type and composition of the respective materials.

A fume extractor according to the respective requirements which is equipped with special dust and activated charcoal filters **must** be installed to ensure that the decomposition products are sucked off where they are produced. A fume extractor also prevents contamination and gradual destruction of optical elements of the beam delivery system by dust particles. DPI offers different fume extractors and accessories including gas regulators and plumbing to provide purge air to the focusing lens.

Please contact DPI for information regarding proper integration of a suitable smoke evacuation system to the LDR system.

## 3.6 Warning Labels and Information

***Warning Labels:*** The following warning labels are mounted on one or more of the following LDR components: laser head, power supply and control pendant.

***Figure 3. Laser Warning Symbol (on the LDR laser head)***

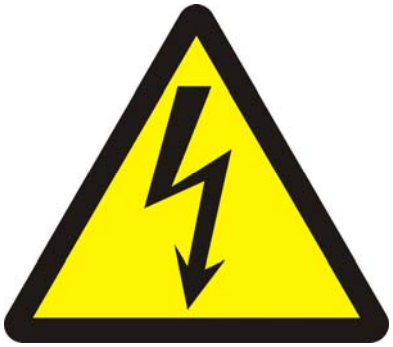


***Figure 4. Electrical Warning Symbol (on the LDR laser head, power supply and control pendant)***


***Figure 5. Laser Exposure Label (on the LDR laser head)***


***Figure 6. Laser Caution Label (on the LDR laser head)***

***Manufacturing Label:*** The following manufacturing label is visible on the rear panel of the laser head enclosure. The Model #, Serial # and Date of Manufacture are laser engraved at the time of manufacture.

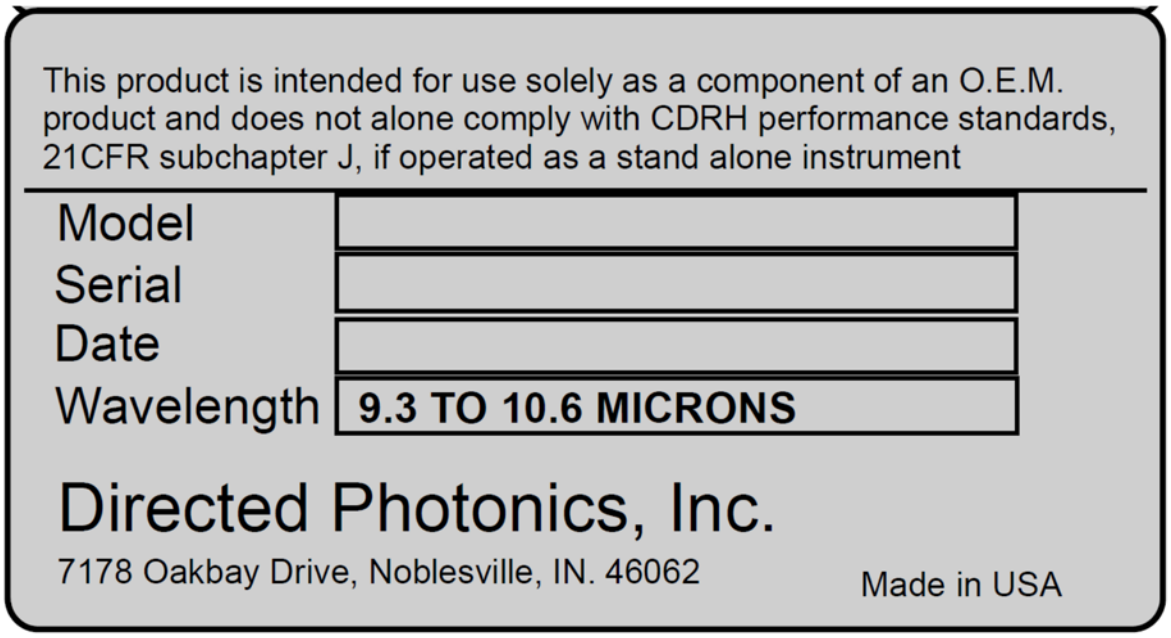



***Figure 7. Laser Manufacturing Label (on the LDR laser head)***

## *3.7 Maintenance and Service Training*

**NOTICE**

It is recommended that a person responsible for the safety of the laser system trained as the laser safety officer. In order to facilitate safe performance of all necessary maintenance and service tasks without assistance and to ensure highest safety for the operating and maintenance personnel, DPI offers special on-site and DPI-based training seminars.

Trainees will gain the knowledge required to perform many maintenance and service tasks at the laser system safely and professionally without assistance. Additional training and maintenance/service information material may be obtained from DPI.

# 4.0 LDR Laser Unpacking and Installation

## 4.1 Unpacking

**CAUTION**

1. DO NOT UNPACK THE LDR COMPONENTS UNTIL SYSTEM INSTALLATION IS IMMINENT! This means that the mounting structure for the laser head should be installed prior to unpacking and the interface electronics have been prepared.
2. Remove the individually packed components from the packaging transport boxes and save the transport boxes for later service use.
3. Check all parts for damage during transport.
   In case of damage please inform DPI in writing (e-mail is acceptable). Keep the packaging material and note damages on the inside and outside. Take pictures, if possible.
4. Transport the laser system and the components to the intended place of installation.
5. Protect the laser system and all components from dust and humidity until installation.

## 4.2 Installation and Start-Up

Installation and start-up of the laser system is fairly straightforward. It is recommended that the installation be accomplished by personnel of DPI or one of DPI's representatives only.

In order to facilitate quick and easy start-up please prepare the place of installation such that the system can be installed with minimum time delay. Interface considerations for electrical, air and water requirements are given in the chapter on Specifications. The steps for installation are:

1. Mount the laser head assembly to the mounting structure (see following layout drawings for mounting geometry locations).
2. Place the power supply unit in an area near the laser head.
3. Mount the control pendant in a readily accessible place for the user.
4. Attach the laser head to the power supply unit via the umbilical cable.
5. Attach the interface electronics to the 9-pin and 25-pin Bulgin connectors on the back of the laser head.
6. Attach the correct lens assembly to the single or dual head optical attachments.
7. Connect the LDR to AC power per the requirements in the chapter on Specifications.
8. Connect the cooling water and smoke evacuation components to the system.
9. Connect the USB-A male connector to the preset GUI device (PC, tablet or Android smartphone) per the instructions in the appendices to this document.

**NOTICE**

In the event any of the above steps are unclear or other questions/concerns arise during installation, please contact DPI Technical Support directly by telephone.

The company operating the laser system is responsible for the safe use of the laser system, especially for meeting the local codes and regulations regarding the operation of laser systems and their components (beam protection, fume extractor, cooling, etc.). Moreover DPI does not accept responsibility for any damages due to misuse of equipment, incorrect operation or negligence.

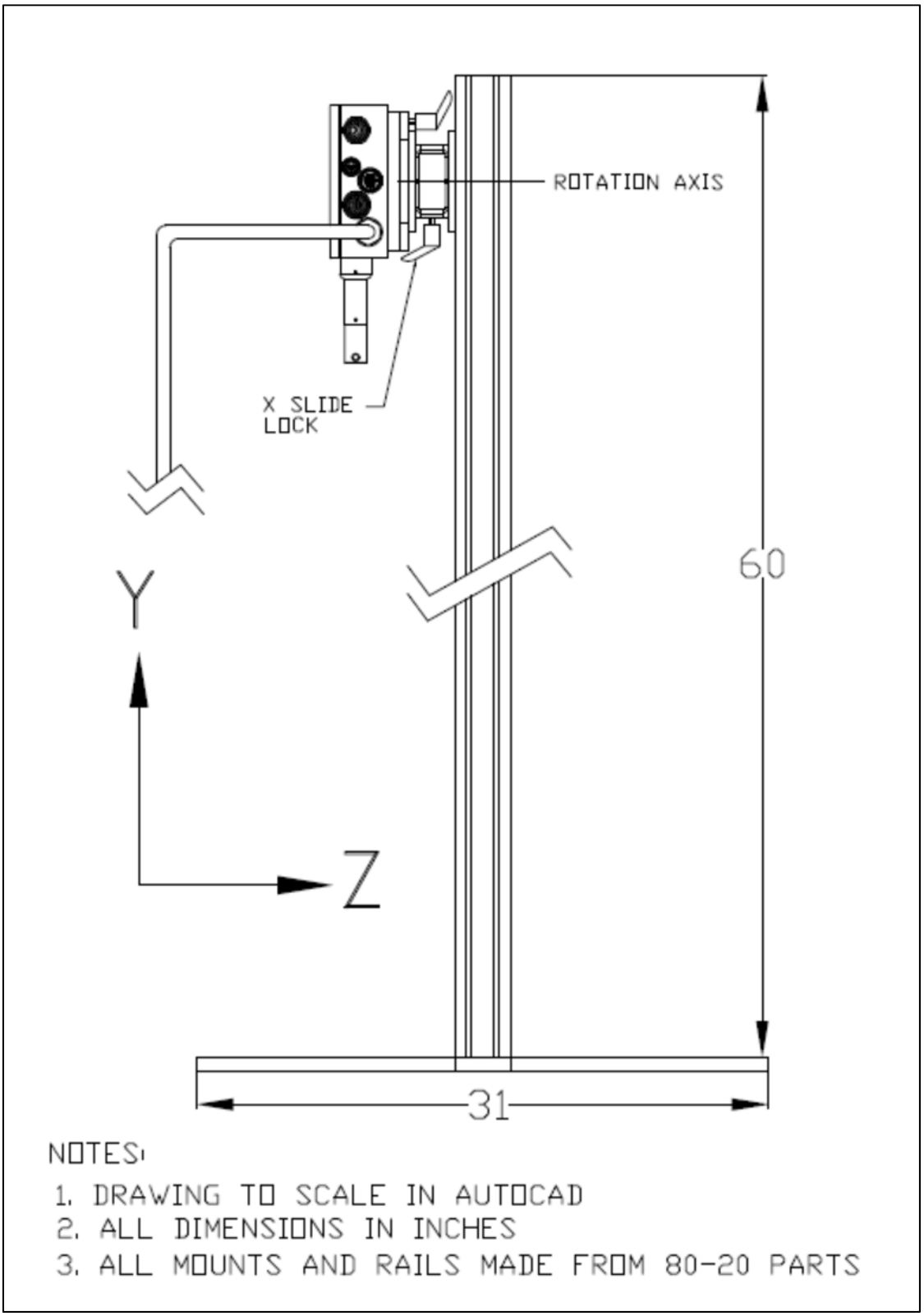



***Figure 8. LDR Laser Head Mounting, Front View (dimensions in inches)***

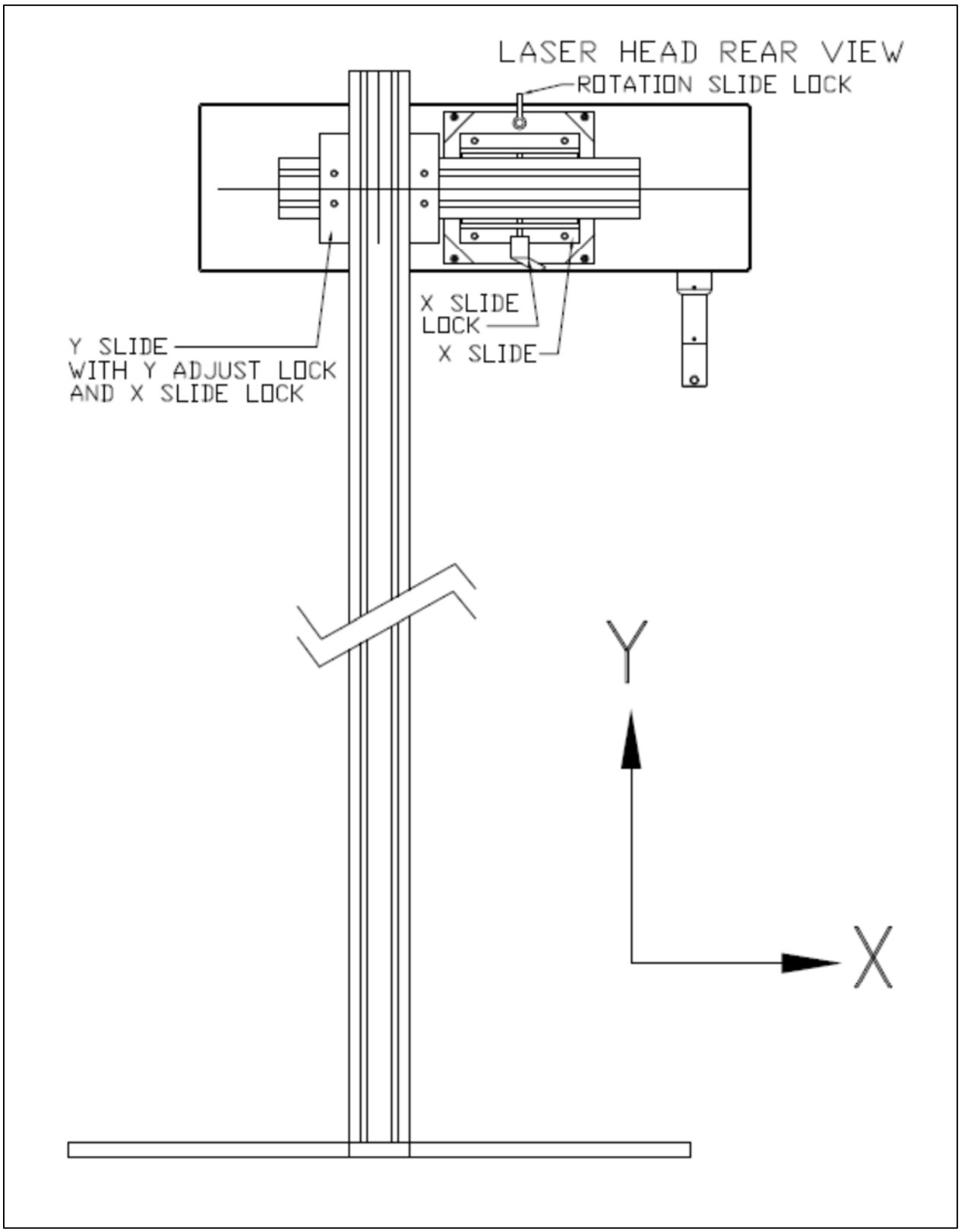



***Figure 9. LDR Laser Head Mounting, Mounting Plate Side View***

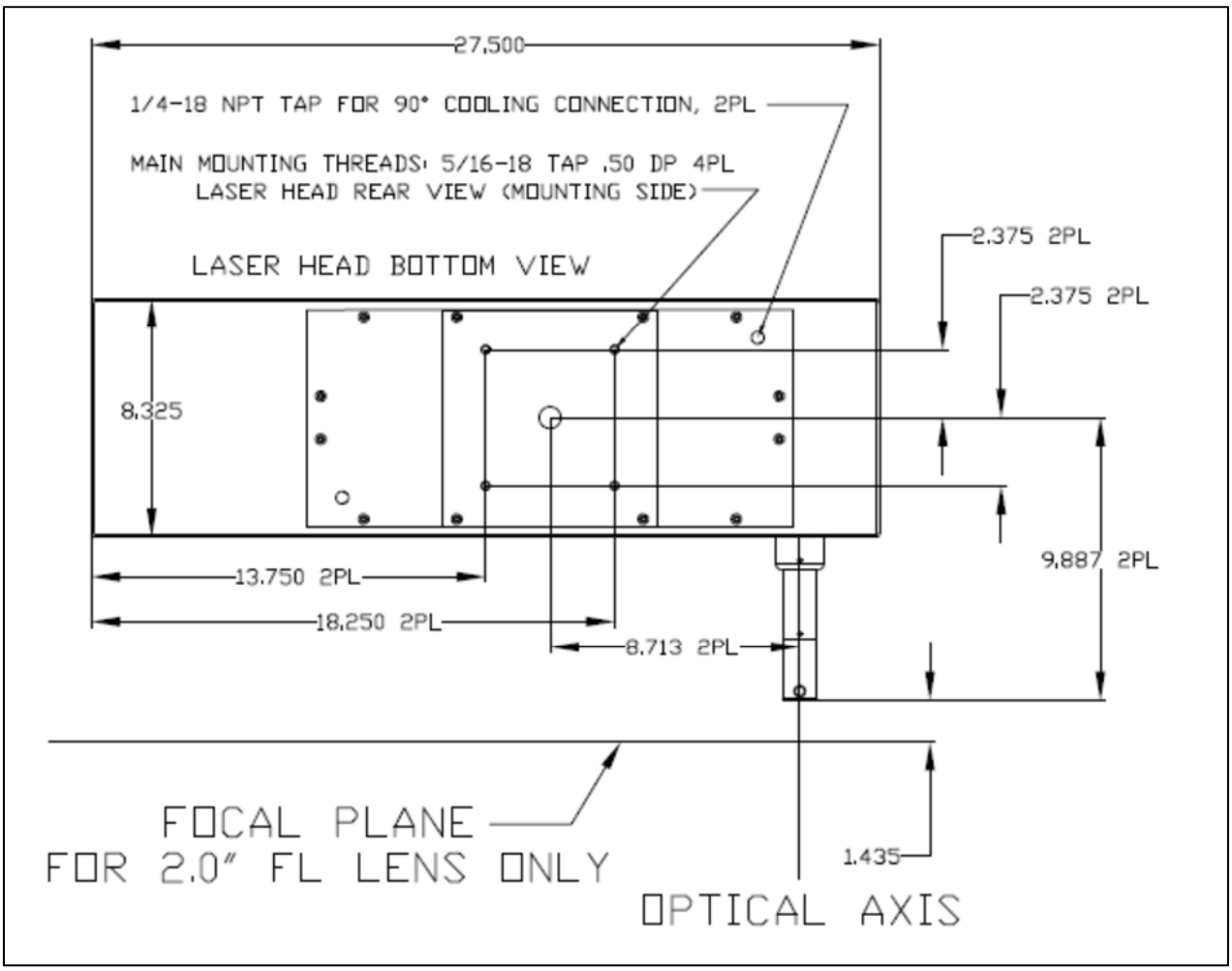



***Figure 10. LDR Laser Head Mounting, Mounting Plate Detailed Side View (dimensions in inches)***

## 4.3 Cooling System

The laser system is cooled by closed cycle water or compressed air. DPI supplies these systems as optional accessories and information on these components can be obtained by contacting DPI directly. The cooling system is designed to supply sufficient cooling to the LDR laser head unit. The LDR laser head is automatically protected against over-heating via internal temperature detection systems. In certain cases where low laser head power consumption occurs, the laser head can be cooled by directing external fan air directed at the laser head enclosure.

## 4.4 Fume Extractor System

In order to remove marking residues which might be dangerous to health a fume extractor must be installed as part of the entire LDR system. DPI supplies these systems as optional accessories and information on these components can be obtained by contacting DPI directly. The fume extractor provides a method for safely removing particles and fumes which are produced in the marking process. These particles and fumes are drawn away directly at the place of the formation to prevent accumulations of material that can damage the optical components of the system

## 4.5 Interfaces to the LDR Laser System

***Interface Connectors:*** The LDR laser head has the following system connectors located on the back end of the unit as shown in the following figure:


**Figure 11. LDR Laser Head Rear Panel Connectors**

**25-Pin Connector (C1):** Connector C1 is the primary I/O connector for the LDR system and is primarily used for the controlling I/O to both provide necessary data to the LDR system and output printer status and control data to the operator's external equipment. It includes all of the signals functions listed below by pin number.

| 25-Pin Connector Pinouts | | |
|---|---|---|
| **Pin #** | **Function** | **Comments** |
| 1 | +12 VDC | To power detector |
| 2 | Product Detector Input "A" | |
| 3 | Product Detector Input "B" | |
| 4 | Ground | Ground for detectors “A” and “B” |
| 5 | +12 VDC | To power encoders |
| 6 | Shaft Encoder Input "A+" | |
| 7 | Shaft Encoder Input "A-" | |
| 8 | Shaft Encoder Input "B" | |
| 9 | Shaft Encoder Input "B-" | |
| 10 | Ground | Ground for encoder "A" |
| 11 | Ground | Ground for encoder "B" |
| 12 | +12 VDC | To power user I/O |
| 13 | User Output "A" | |
| 14 | User Output "B" | |
| 15 | User Input "A" | |
| 16 | User Input "B" | |
| 17 | User I/O Return Ground | Ground for User I/O "A" |
| 18 | User I/O Return Ground | Ground for User I/O "B" |
| 19 | Remote Mark Enable Input | +5V to +36V |
| 20 | Ground | Ground for remote mark enable |
| 21 | +12 VDC | To power indicators |
| 22 | Mark Enable Indicator Output | |
| 23 | Emission Indicator Output | |
| 24 | Ground | Spare ground |
| 25 | Shield Ground | Charge Drain for PDET & ENC |
| | | |
| Note: | All outputs buffered 500 mA @ 12 V | |

**Table 2. 25-Pin LDR Interface (C1) Signal Pin-Outs**

**Connector “USB”:** Connector C2 is the primary GUI interface control connector for the LDR system. It is a flying-lead male USB-A connector which can be driven by various programmed GUI devices as detailed in the appendices to this document.

**Connector “Ethernet”:** Connector C2 is the Ethernet interface control connector for the LDR system. It is a water-tight IP65 female RJ45 connector.

**9-Pin Connector (C2):** Connector C2 is the secondary I/O connector for the LDR system and is primarily used for the specific I/O signals primarily related to the system interlock circuit and the alarm lamp status. It includes all of the signals functions listed below by pin number.

| 9-Pin Connector Pinouts | | |
|---|---|---|
| Pin # | Function | Comments |
| 1 | +12 VDC | Spare +12 VDC |
| 2 | Red Alarm Output | |
| 3 | Amber Alarm Output | |
| 4 | Green Alarm Output | |
| 5 | Ground | Ground for alarms |
| 6 | Interlock Enable Output | |
| 7 | Interlock Return Ground | |
| 8 | +12 VDC | Spare +12 VDC |
| 9 | Ground | Spare ground |
| | | |
| Note: | All outputs buffered 500 mA @ 12 V | |

**Table 3. 9-Pin LDR Interface (C2) Signal Pin-Outs**

# 5.0 LDR Laser System Functional Overview

## *5.1 The LDR Optical Geometry*

The LDR uses a matrix of 5, 7 or 9 $CO_2$-lasers (herein each laser module assembly called a laser module) which are each operated in a highly controlled pulsed mode. Each laser module beam is angled via a system of turning mirrors to give a fixed angular separation between the beams. The matrix of beams all meet at the crossover point which is located in front of the final focusing lens by exactly one focal length distance. This produces what is called a “tele-centric beam path” such that the separation of the beams remains constant after leaving the final focusing lens thus preventing a “butterfly” mark effect on curved laser marking substrates.

A graphical representation of a 7-dot LDR optical system is shown in Figure 1. Here the 7 angulated laser beams crossover just before the focusing lens at which point the lens makes the beams tele-centric (parallel) to focus at the target substrate. The vertical separation of the focused dots at the target create the fixed character height, H.

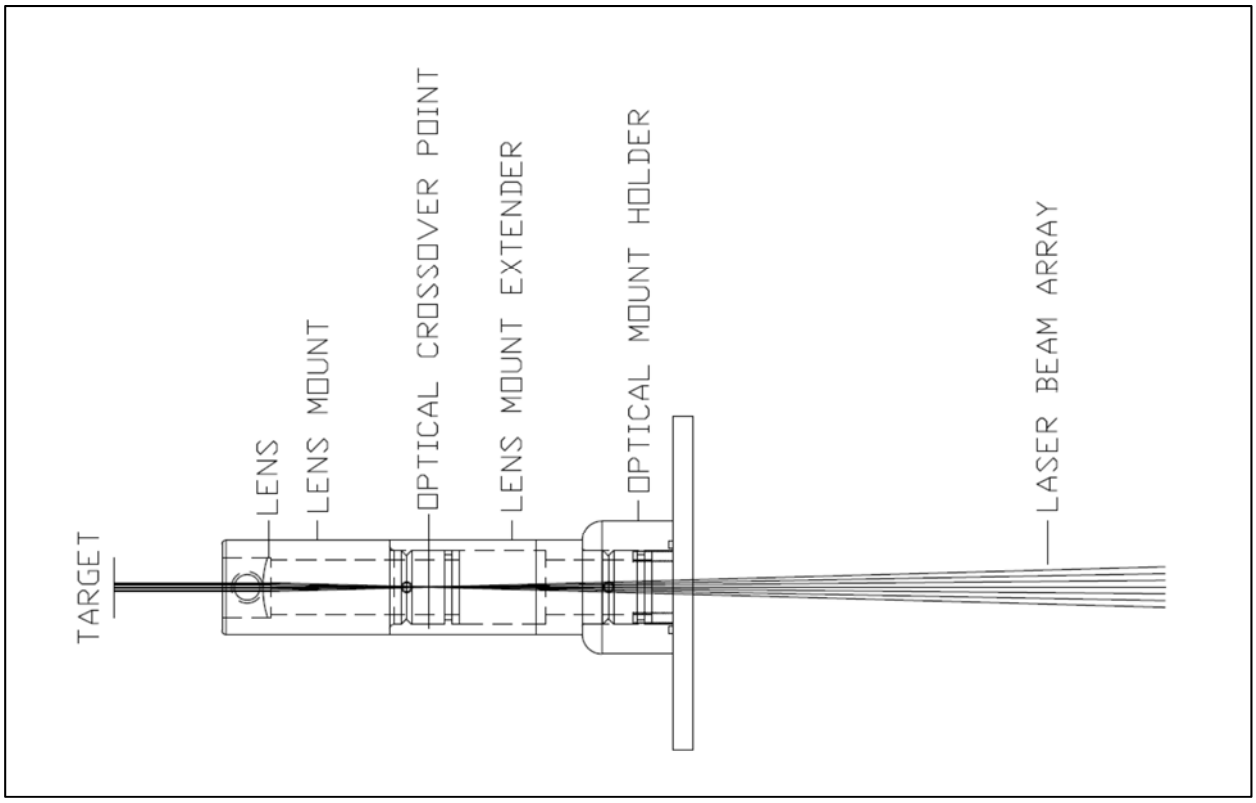



***Figure 12. Geometric Optical Layout of the 7-Dot LDR***

The LDR laser assembly uses 5, 7 or 9 lasers mounted in a parallel fashion. The independent laser beams are then directed by a series of fixed mirrors (the optical turning block) to produce a precise fan of beams which meet at the optical crossover point in the focusing lens attachment. This fan shape then produces a series of focused dots at the focal plane which are uniformly spaced based upon this fan angle and the focal length of the lens. The geometric optical layout of the LDR laser head for the 7-laser system is shown below.

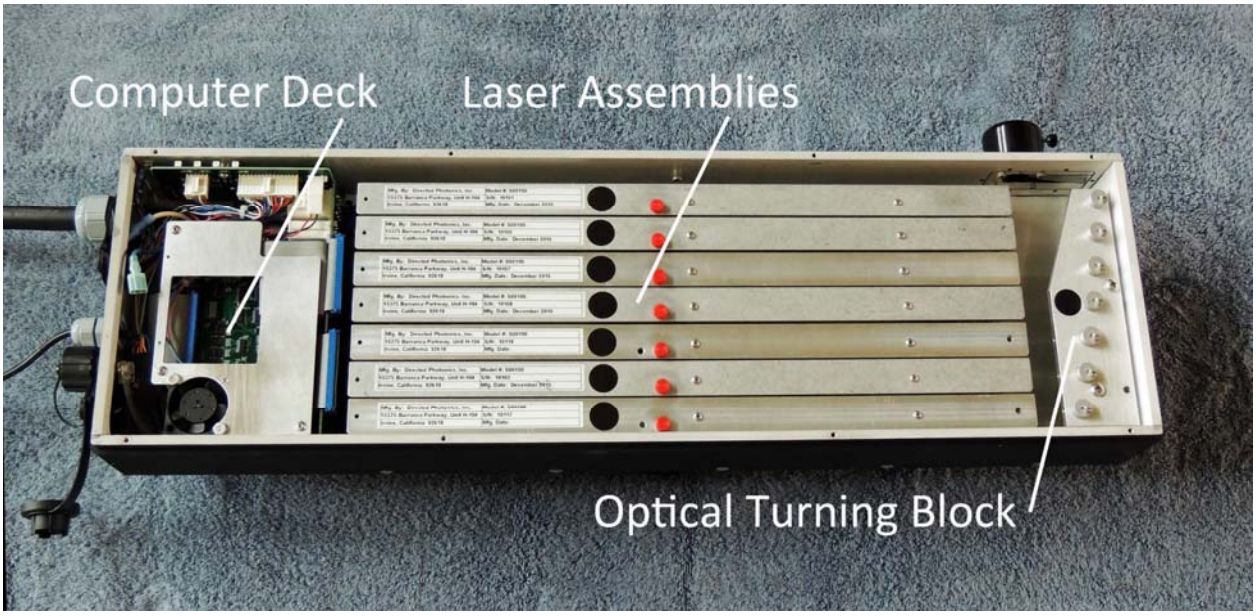



***Figure 13. Physical Optical Layout of the 7-Dot LDR***

After passing through the focusing lens, the dots will produce a standard character height of very close to the formula:

$$H = (N-1) \times F \times \theta$$

Where H is the character height, N is the number of lasers, F is the focal length and $\theta$ is the angle between and adjacent laser beams (in radians). When the high resolution lens option is used, the character height is slightly larger by roughly 20%. A table of character heights versus focal lengths is given below for the standard lenses. The HR lens increases the value of H by roughly 20%.

| Focal Length (Inches) | Character Height "H" (Inches) |
|---|---|
| 1.0 | .06 |
| 1.5 | .09 |
| 2.0 | .12 |
| 2.5 | .15 |
| 5.0 | .30 |
| 7.0 | .40 |

***Table 4. LDR Character Height with a 7-Dot LDR Standard FL Lenses (dimensions in inches)***

## 5.2 The LDR Laser Marking Methodology

The figure below illustrates the production of dots to produce a character (the letter “E”) in a 7-dot machine on a moving product. As the product substrate moves in front of the LDR lens, the dots are turned on and off like a series of light bulbs in a precisely timed sequence to produce precision alphanumeric characters as well as symbol art.

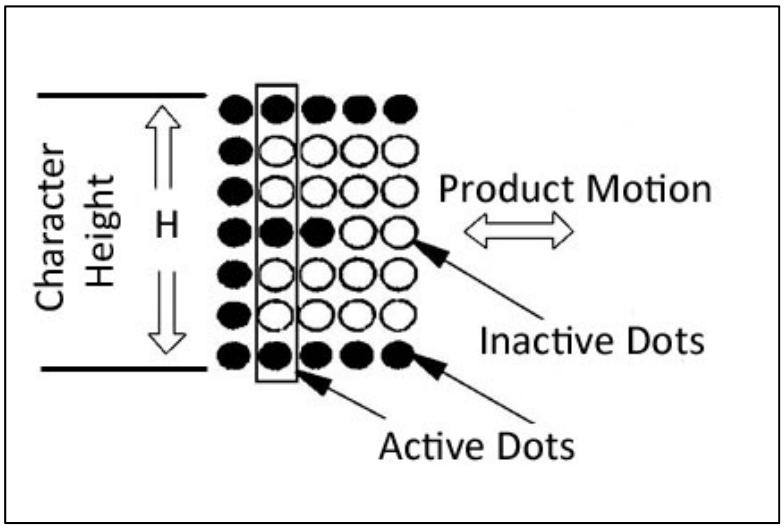



***Figure 14. Production of Alphanumeric Characters Using a 7-Dot LDR***

## 5.3 The LDR Laser Modules

The LDR uses a matrix of 5, 7 or 9 $CO_2$-lasers (herein each laser module assembly called a laser module) which are operated in pulsed mode only. Each laser module is classified as class 4.They each produce invisible (infrared) radiation which is dangerous for the eye and skin. These lasers cannot be operated outside of the LDR system as they have no internal power source unless plugged into the LDR. With instruction from DPI technical personnel, the laser modules can be changed out in the field by the user/operator.

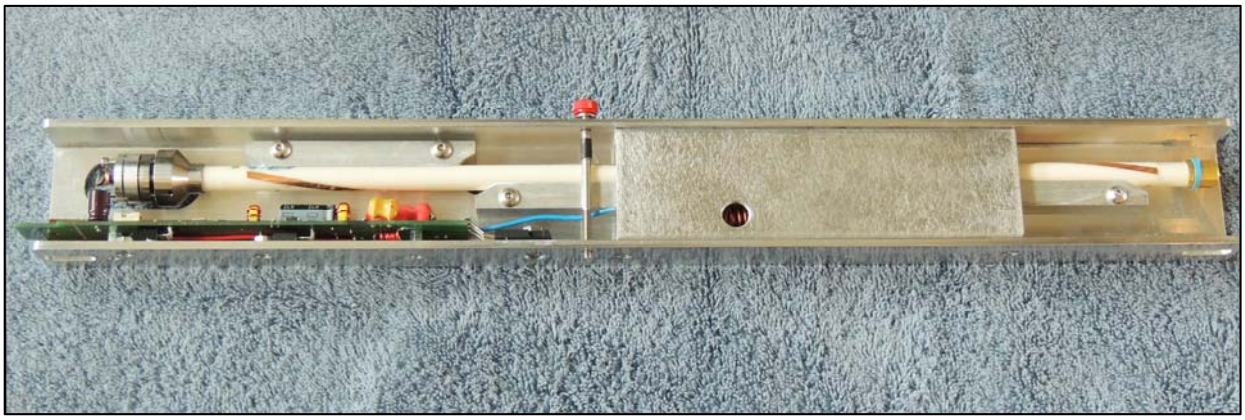


***Figure 15. Single LDR Laser Module***

The pulsing of the lasers is controlled by the GUI interface hardware employed (see Appendix A) and the control software (see Appendix B). The system in total when properly integrated into production equipment allows digital real-time data to be permanently marked on moving substrates at high speed. Each laser is capable of producing up to 30 watts of peak power for pulses as short as 50 usec.

## *5.4 The LDR Power Supply Module*

The LDR power supply module is intended to be placed near the LDR laser head but can be put under a production line to minimize the system footprint. It has no lights or switches that need user/operator monitoring or control inputs. When AC power is supplied to the power supply unit, the power control function of the LDR is transferred to the control pendant. The power supply unit has internal fusing and a current in-rush limiter. A top view of the power supply unit with fan cooling pack is shown below.

***Figure 16. LDR Power Supply Module (Top View)***

***Figure 17. LDR Power Supply Module (Front View)***

## *5.5 The LDR Dual Line Print Attachment*

The LDR allows for various optical attachments to be used for various applications. The LDR matrix of 5, 7 or 9 $CO_2$ lasers can be duplexed to create two lines of print. This dual line printer attachment option is integrated at the factory and cannot be field retrofit without DPI on-site assistance and calibration. The two lines of print are not produced simultaneously but one line of print can be the maximum permissible character length while the 2nd line of print may be as long as 1.20" in length. The same lenses used on the single line attachment will fit the dual line attachment but two lenses are needed. The dual line attachment is shown below.

***Figure 18. LDR Dual Line Attachment***

# 6.0 LDR System Block Diagrams

The LDR system block diagrams are shown below. Detailed schematics of the full system including part numbers are available from DPI technical support. It is highly recommended that the user/operator contact DPI technical support for any issues relating to the electronics and/or wiring issues with the LDR system.

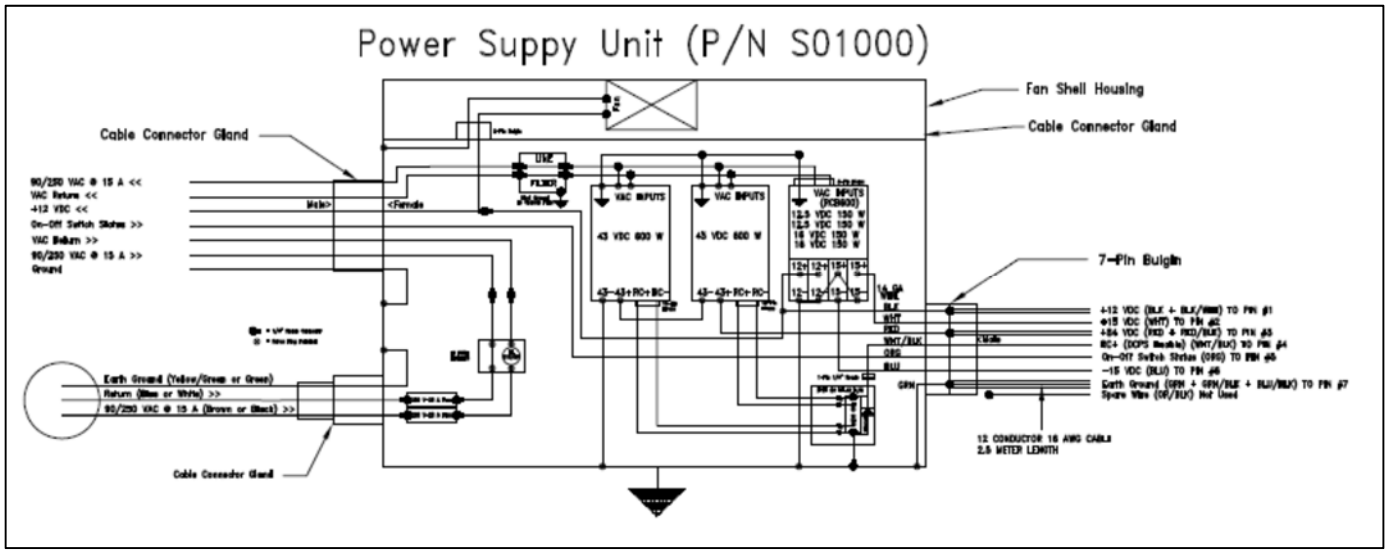



*Figure 19. LDR Power Supply Unit Block Diagram*

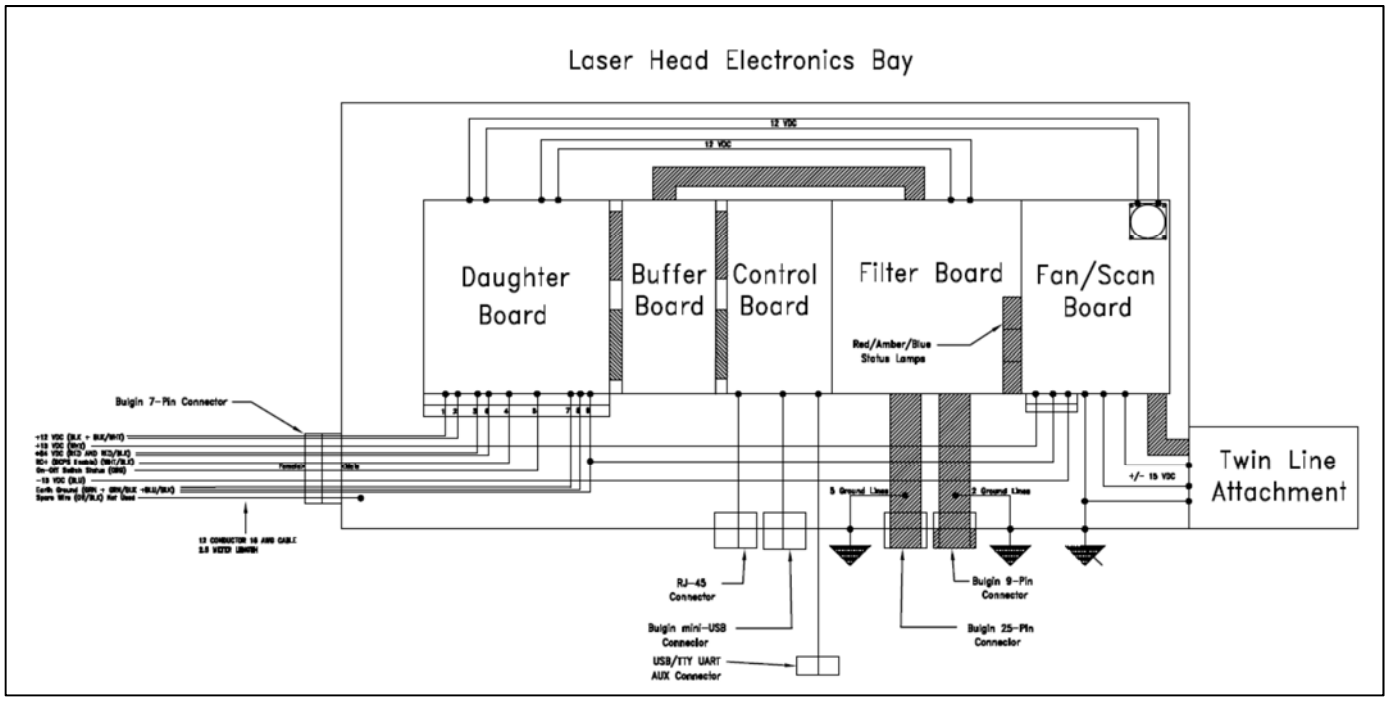



*Figure 20. LDR Laser Head Block Diagram*

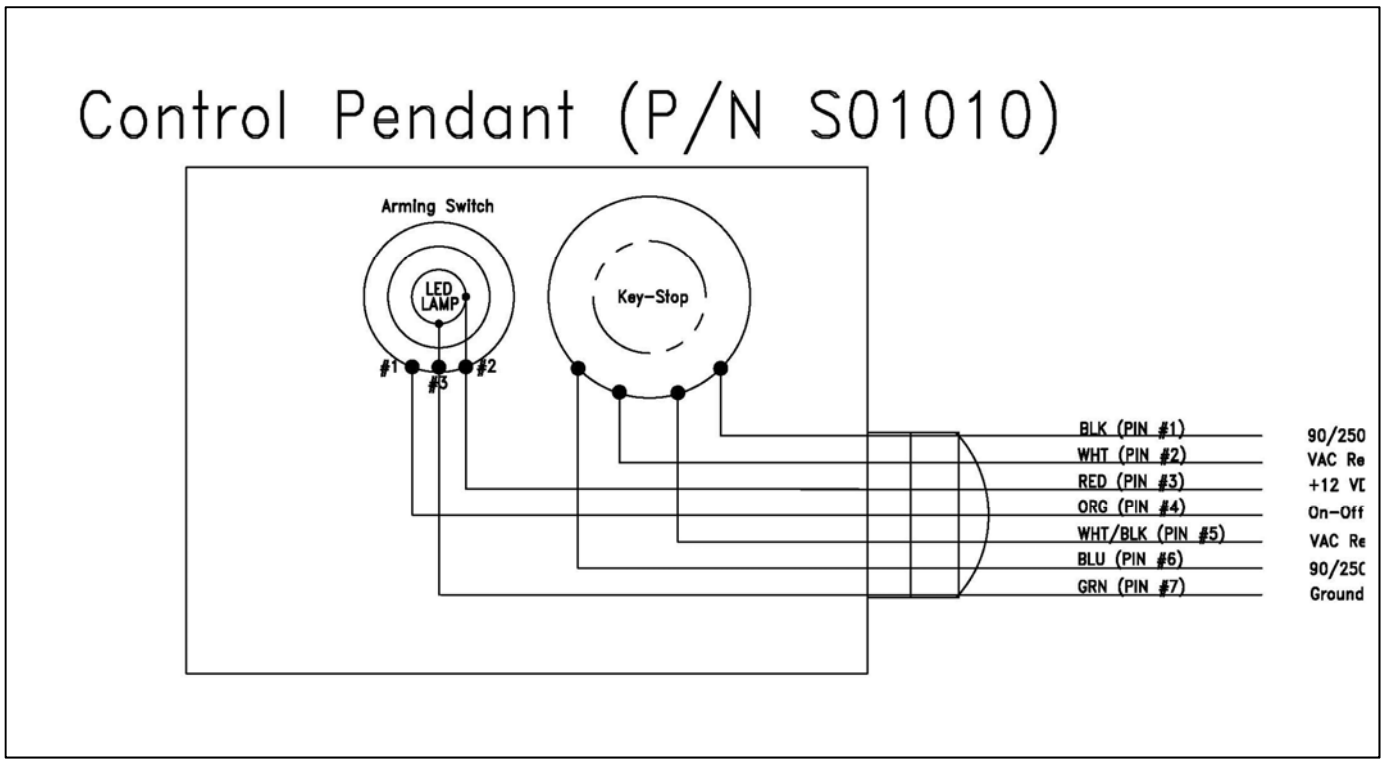



***Figure 21. LDR Control Pendant Unit Block Diagram***

# 7.0 Specifications: DPI LDR Series (Preliminary)

**System Features:**

- High speed all-digital laser marking system with IP65 rating on the laser head, control pendant and power supply modules
- IP65 rating on the laser head, control pendant and power supply modules
- 200 Watt nominal laser peak power (7 laser system). 5 and 9 laser systems also available
- State-of-the-art communication interface (USB/PAD and Smartphone)
- 2 Cabinet IP65 System, laser printer and power supply
- Enhanced RF stability and cold start-up performance
- Advanced RF-pumped laser tube technology
- 9.3-micron, 10.3-micron and 10.6-micron laser wavelengths available (optimum laser marking on PET plastic @9.3-microns)
- Plug and play laser modules (customer serviceable)
- USB and RJ45 control interfaces including Laptop, PAD and Smartphone user interface

**Printing Features:**

- Lines of Text: One or Two
- Character Generation Up to 2,000/sec (single Line) or 4,000/sec (two line) with standard lasers (substrate dependent)
- Line Speed Up to 250m/min standard lasers (substrate dependent)
- Print Formats 5x5, 5x7, 5x9, 7x5, 7x7, 7x9, 9x5, 9x7, 9x9 **L**aser **D**igital **R**esolution, Enhanced Lens Option
- Character Height Range: 2.0mm up to 10mm (0.08" up to 0.40")
- Message Length Up to 253 characters per message line
- Message Storage 16 complete dual line messages

**Electrical Specifications:**

- Voltage/Current 90 to 240 VAC, 15 A maximum at 50/60 Hz
- Laser printer control signals generated via a high speed imbedded microprocessor in the laser printer head
- Laser electrical I/O and safety connections via laser head 25-pin and 9-pin connectors
- System safety interlocks via both the laser head 9-pin connector and system control pendant (AC power crow bar)

**Laser Tube Specifications:**

- Laser Type: Sealed carbon dioxide, RF Excited, no gas consumption
- Laser power output 20-watt min, 25-watt nominal and 30-watt maximum (wavelength dependent)
- Laser wavelengths 10.6-microns, 10.3-microns or 9.3-microns
- Laser rise/fall times (nominal) 100 microseconds to 150 microseconds nominal
- Maximum marking duty cycle 100%
- Maximum laser bore temperature 50°C
- Laser lifetime (nominal) >80% of nominal laser power at 20000 hours
- Gas refill capability Laser Tube Reprocessing at DPI factory only

**Mechanical Specifications:**

- Dimensions:
  - Laser Head: 693 mm (27.3") long, 203 mm (8.0") wide, 81 mm (3.2") deep
  - Power Supply: 475 mm (18.8") long, 203 mm (8.0") wide, 170 mm (6.7") deep
  - Control Pendant: 150 mm (6.0"), 170 mm (6.8") wide, 76 mm (3.0") deep
- Weight: Laser Head: 18kg (40 lbs), Power Supply: 11.4 kg (25 lbs)

**System Installation:**

- Interlock, fault and remote disable via LDR Control Pendant and 9-pin laser head connector
- GUI smart interface connected to LDR laser head via USB-A male flying lead connection
- Input cooling specification Laser Head: (Water, Ambient or Compressed Air, duty cycle dependent)
- Power Supply: Cooling Fan Pack
- Water-cooled option: >4 l/min (1 gal/min) @ 10-30°C (50°F – 86°F) non-condensing (temperature higher than the ambient dew point)

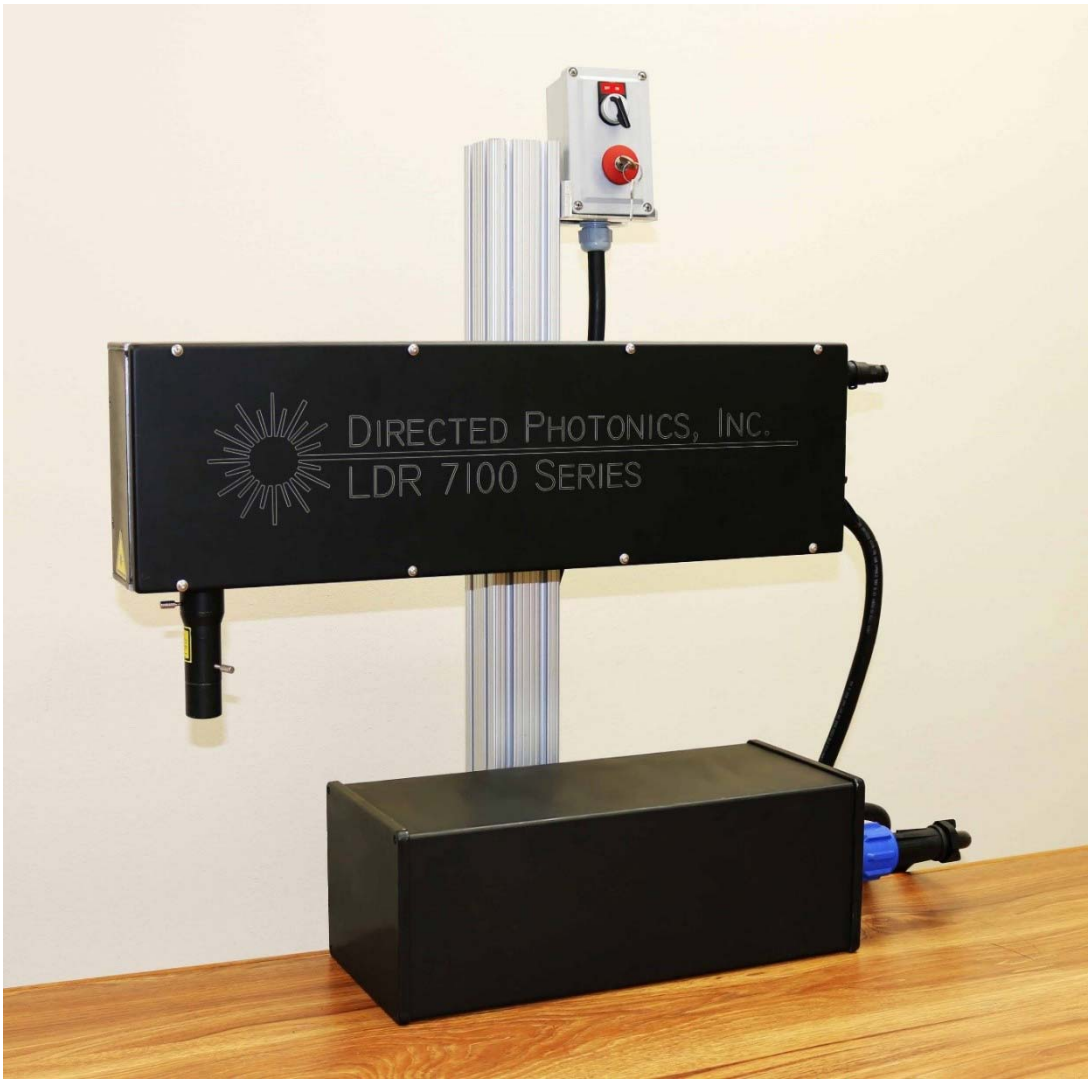
**Warranty: 24 months parts and labor-return to DPI**

**Directed Photonics Directed Photonics**

**Corporate Office:** **7178 Oakbay Drive**
**Indianapolis, IN 46220**
**Tel/FAX: 800-580-4073**

**Manufacturing Facility:** **15375 Barranca Parkway H-104**
**Irvine, CA 92618**

# *Appendix A*
# *LDR GUI Operational Requirements*
# *Revision 1.3*
# *1 September 2016*




***Directed Photonics, Inc., 15375 Barranca Parkway, Unit H-104, Irvine, CA 92618***
***www.dpilasers.com***

***Contact: robert.marusa@dpilasers.com / Tel/FAX: (800) 580-4073***

# LDR GUI Operational Requirements

## Revision 1.3 / 1 September 2016

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## 1. LDR GUI Hardware Overview

The LDR Series of digital CO2 Laser Printers are designed to interface with various GUI computer-based interfaces including PCs, tablets, laptops, smartphones and other devices operating either Windows or Android operating systems. Currently the Windows interface (version 8.1 or 10) and Android App are fully functional in operating the LDR. Note that MS phones are not compatible with the LDR interface as the LDR Windows software only runs as an executable file which MS phones will not. The Android App "DPIConnect" is available for free download from the Google Play Store and is the recommended LDR GUI interface.

For PC-based GUIs, DPI strongly suggests using a multi-function (2 in 1) tablet like the RCA Cambio tablet which is both versatile and rugged with separate charging ports and data interface ports. Although any number of smart GUI-based devices exist and can be used by the user to operate the LDR, there are practical limitations and restrictions for industrial level function. These requirements, limitations and restrictions will be discussed later in this document. The actual executable file used in operating the LDR in a Windows OS is "DPI_Connect.exe" which is available for free download on the DPI website.

Note that the LDR GUI hardware can be detached during LDR operation and the LDR will continue to operate per the programmed commands sent to the LDR from the GUI based upon selected external inputs.

Warning: The LDR USB cable must be connected to the GUI before turning on the LDR. The LDR will not always boot correctly without the LDR connected to the GUI prior to powering up the LDR.

## 2. Hardware Requirements and Recommendations

The LDR GUI Hardware has the following requirements and recommended functional attributes:

1. Windows OS versions 8.1 or 10 (required).
2. A minimum of a 6.0" diagonal screen size useable in portrait orientation (recommended).
3. Separate charging port and USB data port (recommended).
4. Data port may be female USB-A, USB-C or USB-micro (required).

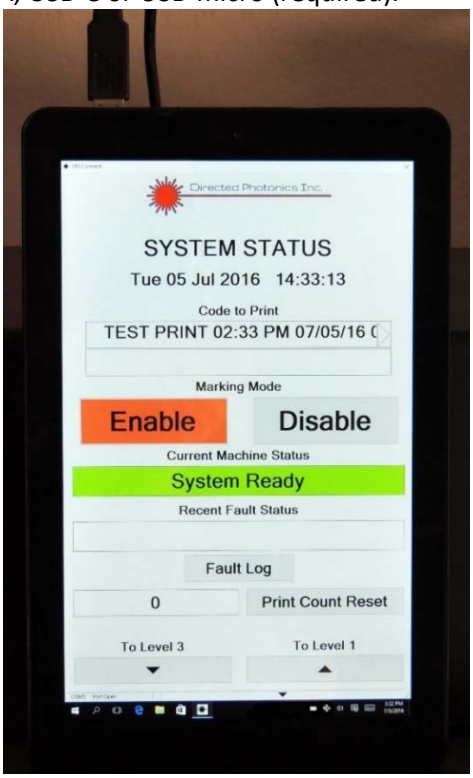



***Figure 1. RCA Cambio 2 in 1 with 10.1" Display Running the DPI_Connect.exe Executable***

## 3. Software Download and Install for PC-Based GUIs

Prior to loading the DPI_Connect software, it is necessary to download and install the USB Serial Driver for the LDR USB connection. The software ZIP file "CDM21218_Setup. Zip" must be downloaded from the DPI website and installed prior to installation of the LDR operating software. The current version of LDR software ZIP file "Software_DPI_Connect……Zip" can be downloaded for free from the DPI website. It is recommended that a folder be put on the GUI desktop (named DPI or LDR or DPI_Connect) to store this ZIP file. The file can then be unzipped and the executable file "DPI_Connect.exe" located and copied to the desktop as shown below.

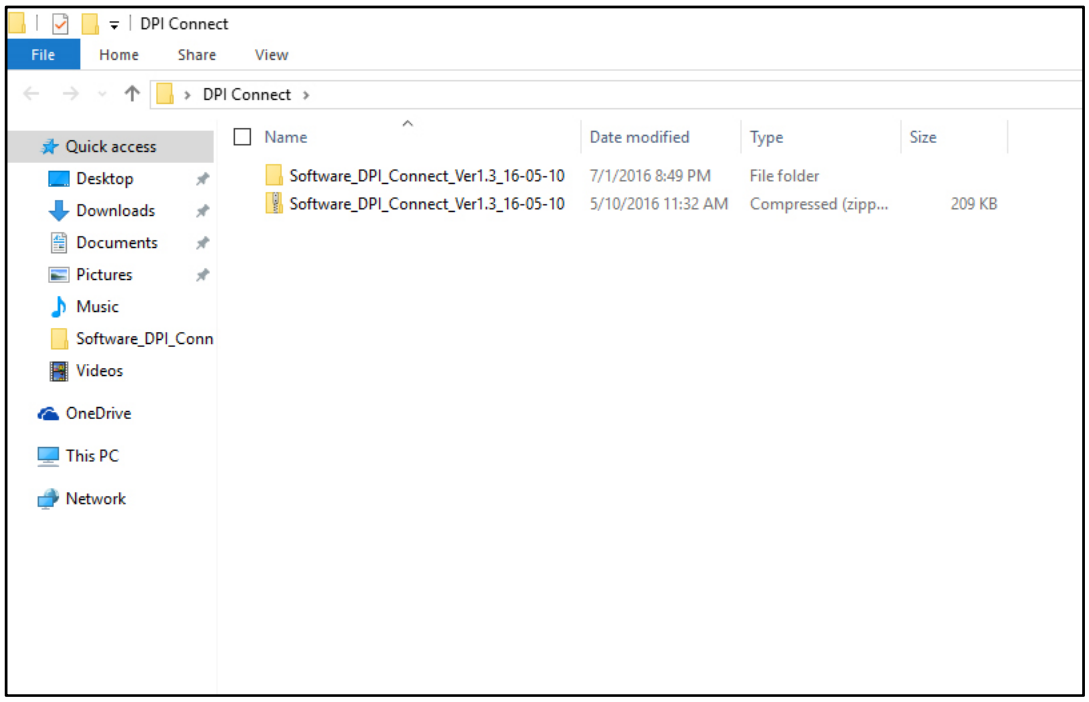



***Figure 2. Folder Location and Files for the LDR GUI Software***

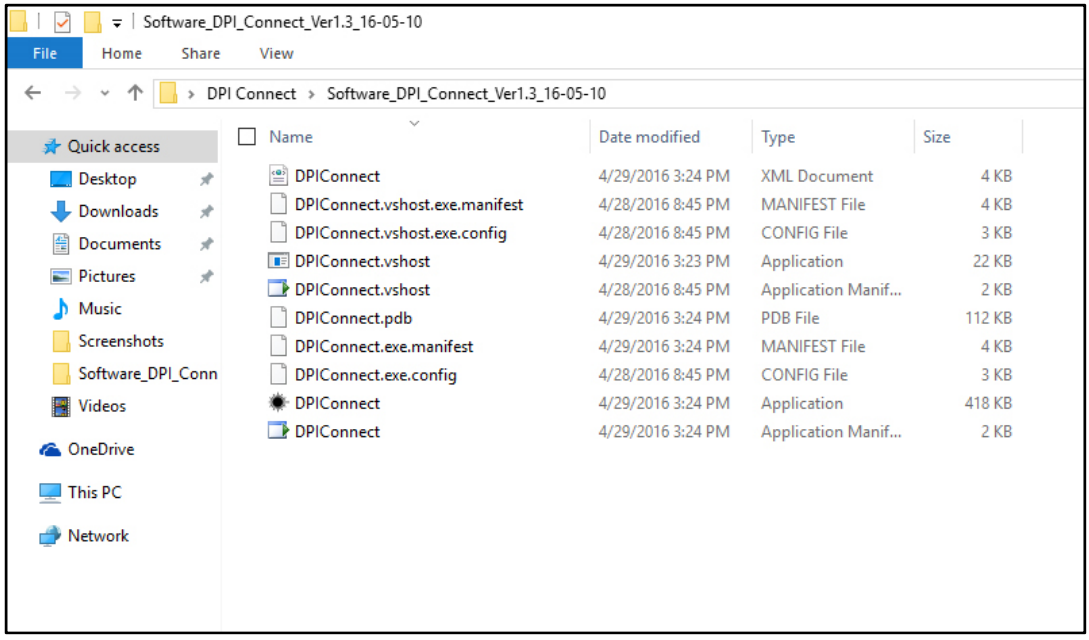



***Figure 3. Location of the DPI_Connect Executable File***


***Figure 4. The DPI_Connect Executable File Copied to the Desktop***

## *4. Locating the Correct COM Port*

When the DPI_Connect icon is activated, a search for available COM ports will occur. If the "UBS LOGIN" screen is not displayed and the green comms light is not blinking, the correct COM port is not connected. By touching the bottom left hand corner of the active DPI_Connect screen, the available ports can be seen.

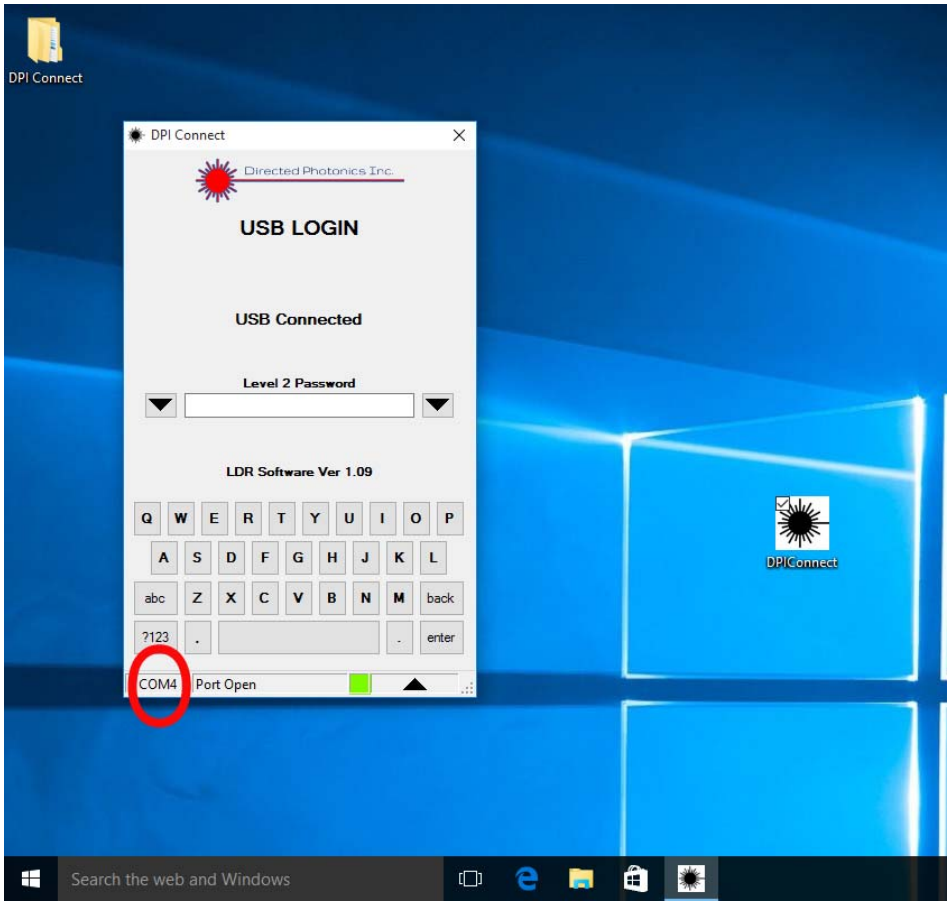



***Figure 5. Location of the COM Port Selection Button***

The correct COM port to select is the USB Serial Port.  The initial COM1 port will not work.

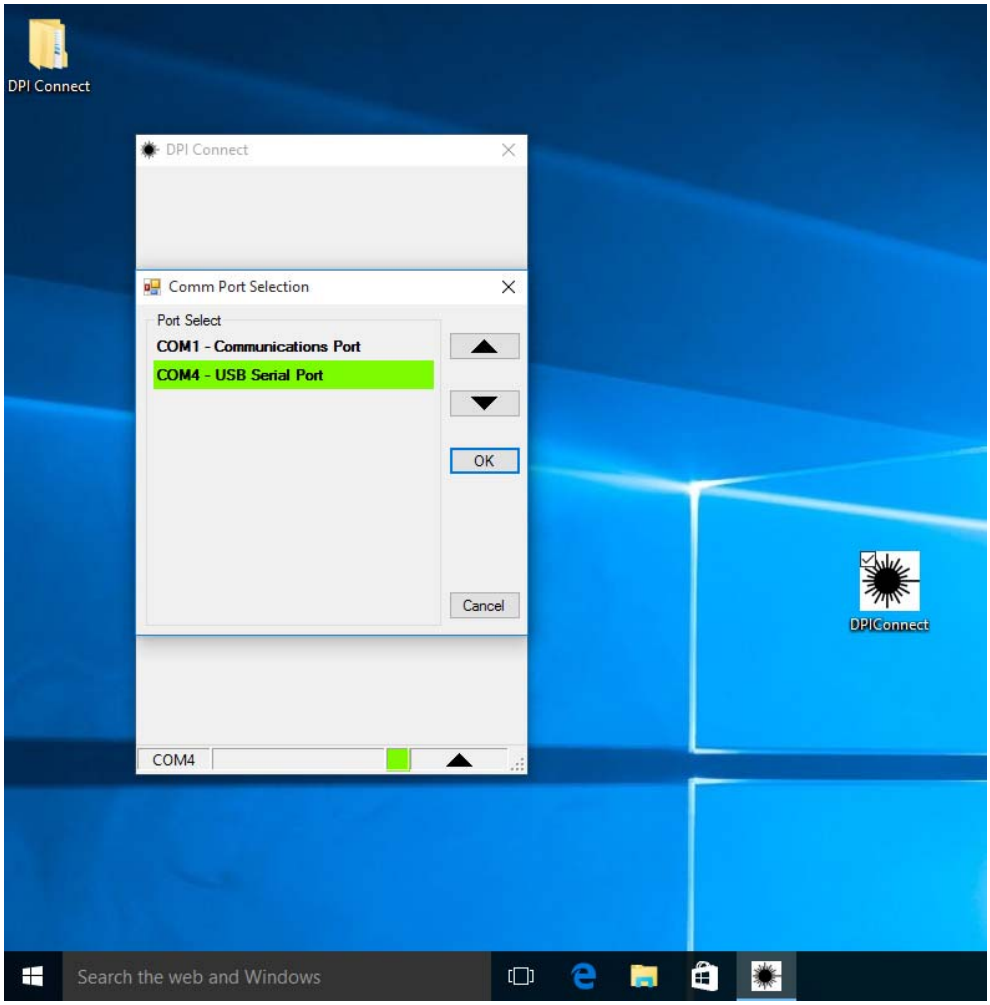



***Figure 6.  USB Serial COM Port Selection***

With the proper USB serial COM port selected and with the LDR powered up, the screen in Figure 5 will appear and the various levels of software can then be accessed with the proper passwords.  The default password setting is set to none so the user can go directly in to all software levels and then set the passwords as desired.

## *5. Operating the LDR Software in Portrait (Large Format) Mode*

The LDR GUI can be optimized for maximum button size and ease of viewing by operating in large format portrait mode. This can be obtained by activating the arrow button in the bottom right hand of the LDR interface screen.

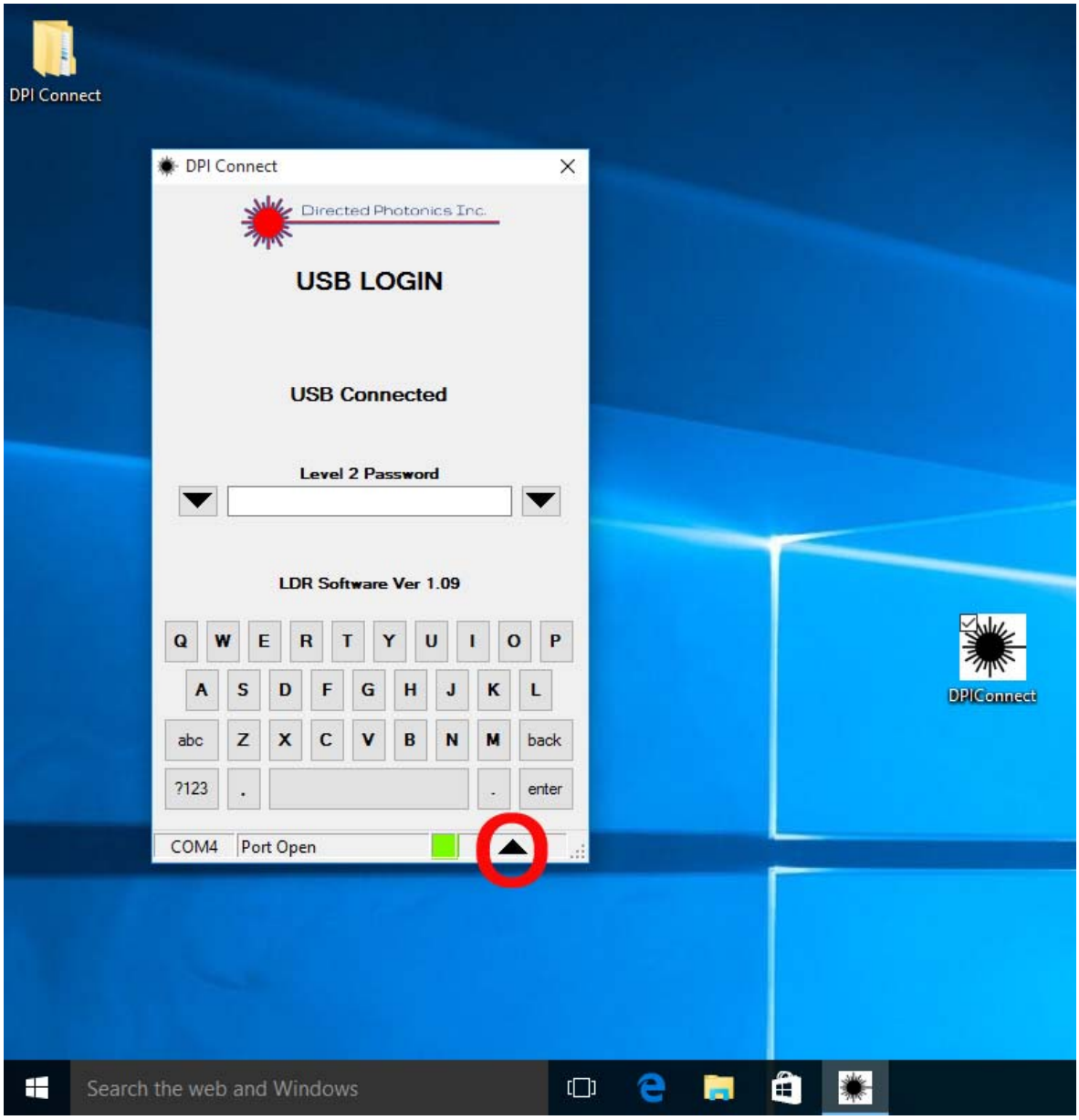



***Figure 7. DPI_Connect Large Format Option***

If the screen is then rotated into portrait mode, the full screen DPI_Connect Software can then be obtained as shown in the next figure which shows the entire tablet in portrait format operational mode.

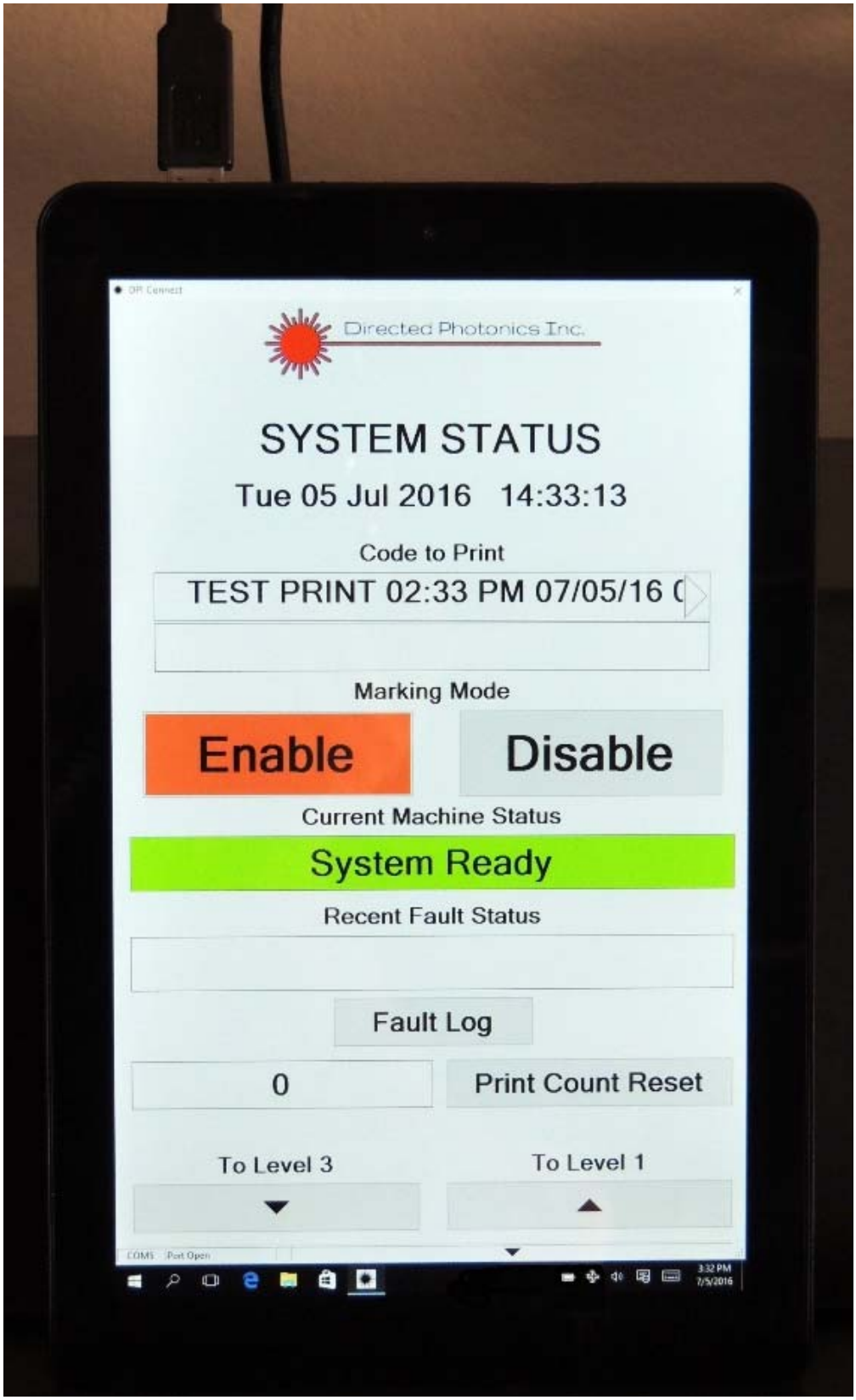



***Figure 8. DPI_Connect Portrait (Large Format) Display in Operational Mode***

## *6. Battery Power Consumption Control*

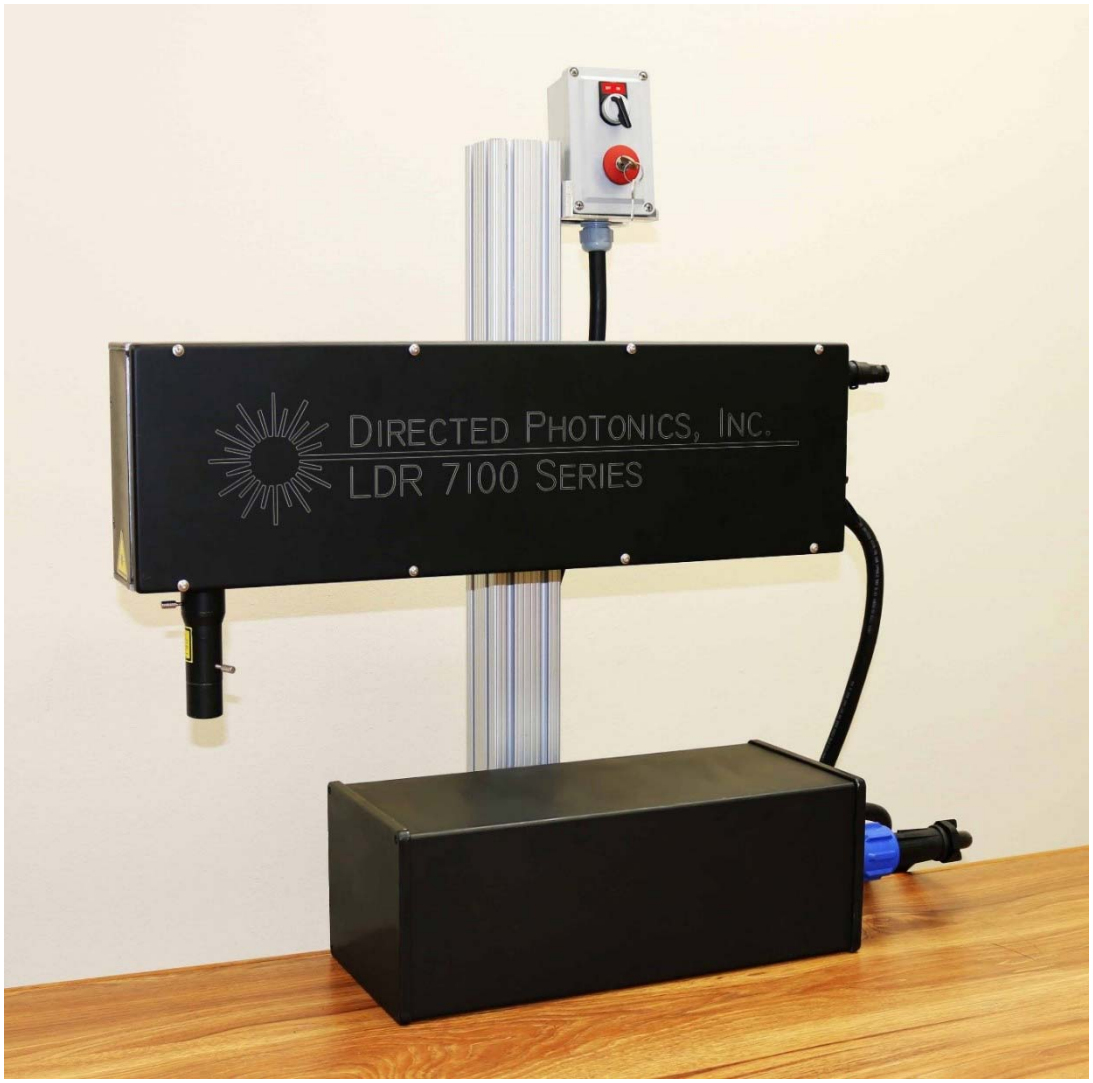
DPI has done extensive testing on reliability and ease of use of various GUI devices for operating the LDR Digital Laser Printer. It is clear that the limiting issue for long term reliability and ease of use is the level of battery charge. Most small GUI devices that could be used to operate the LDR have limited battery lifetime (4 to 10 hours typically when not being charged) which is not exceptionally long. Moreover the power consumption of most GUI devices in sleep mode (typically the mode where the power button is depressed for a few seconds and the screen goes dark) is not viable for keeping the battery in a suitably charged state for more than a few days regardless of the number of background operations (like WiFi being turned off into airplane mode and GPS location detection being disabled) such that an uncharged GUI system in sleep mode will have a dead battery condition in just a few days but not more than a week. Thus if the LDR is turned off in a production environment during a holiday or long weekend where no LDR usage is occurring and with the GUI not in non-charging sleep mode, the user may be surprised to find that the GUI will not boot after the long hiatus and moreover in some GUI devices, the GUI will be unrecoverable requiring return shipment to the manufacturer to recover the GUI hardware.

DPI therefore strongly suggests that the following conditions be maintained on the GUI hardware:

1. The data port and charging ports should be independent of one another.
2. When the LDR system is being turned off or shipped for a period of more than two days without battery charging, the GUI must be turned hard-off (long depress of the power button until Windows indicates that the GUI is shutting down).
3. When not in use but located in a ready-to-go state for production, the GUI should remain plugged into DC power even if the LDR machine itself is turned off.
4. The user should maintain a ready-to-go back-up GUI in the event of a fatal battery drain event.
5. DPI strongly recommends that sleep mode be turned off on the GUI whenever the GUI is connected to the LDR to prevent undesired shutdown of the LDR.

Testing also reveals that regardless of how many background applications and battery saver techniques are applied to the GUI, the non-charging sleep mode for most GUI devices can be long term fatal. It is DPI's opinion that fatal battery draining event are the sole limiting reliability issue with the LDR system.

# *Appendix B*
# *LDR Software Instruction Manual*
# *Revision 2.0*
# *25 July 2017*




***Directed Photonics, Inc., 15375 Barranca Parkway, Unit H-104, Irvine, CA 92618***
***www.dpilasers.com***

***Contact: robert.marusa@dpilasers.com / Tel/FAX: (800) 580-4073***

# LDR Software Manual
## Revision 2.0 / 25 July 2017

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## Software Overview and Features

### *Overview*

The LDR Series of digital CO2 Laser Printers are designed to mark moving substrates, flat or curved, at high speed in harsh industrial environments. With an IP65 environmental rating and providing up to 300 peak watts peak of highly focused laser power, the LDR meets the most demanding marking requirements needed for dynamic high-speed production lines in the world today. Dot matrix and high resolution print fonts can be obtained with the standard 7 or 9 laser channels. The LDR marks the culmination of nearly 30 years of development and is the only digital laser coder of its type in the world.

The control software for the LDR system addresses the communication technology developments in the industrial market. The LDR can be operated via hand-held Tablet or Smartphone devices wherein the Tablet or Smartphone (the Smart Interface or herein "SI") running the DPI>>Connect software or App and operating as USB-connected terminal emulators, are able to build, control and command printing of the LDR. Moreover the controlling SI can be removed (or reattached) after marking is enabled and the LDR will continue to operate under automatic control. The automatic print control will be terminated via a series of safety and print control states or commands that can automatically or manually be activated by the user.

### *Features*

The LDR Software Interface has numerous control and interface features which are essential for continuous long-term quality production laser marking and coding:

5. The SI can be operated from any MS-based or Android-based tablet, Tablet or Smartphone using the DPI>>Connect executable or DPI Connect App available at the Google Play Store.
6. The LDR provides a TTY-UART USB interface cable with a USB Type-A connector.
7. Some SI devices run with Micro-USB which can be obtained via a Micro-USB / Type-A OTG interface jumper cable.
8. The mark to be printed is easily assembled from a set of code blocks and can be assembled in any order the user desires using code block formats provided on ancillary support screens.
9. In the mark enabled state, the SI can be removed or reattached at any time.
10. Password protection for the various operating and message assembly parameters may be set by the user.
11. The message screens described later in this document are highly intuitive so that the user can readily and easily navigate the message screens and obtain the desired mark message, format and control.
12. The software updates can be easily installed by the user from website downloads of the updated executables and Apps.
13. Firmware updates can be accomplished in-situ in minutes at the user site via a service call by a trained technician in the event that firmware updates occur.
14. The LDR has a Control Pendant which contains an E-Stop (with key-switch) and an Arming Switch which are key safety devices for the LDR system. When activated these two devices will (i) completely shut down or (ii) disarm (stop marking) of the LDR respectively regardless of the LDR software status.
15. The SI software continuously monitors the status of the LDR including external inputs (such as interlock activation, product detect, encoder inputs, etc.) and internal safety checks (such as laser control status, system temperature, voltage status, etc.) and displays and issues detected in a Fault Log for user action.

16. There are four System Status LEDs (green, red, amber and blue) built into the LDR laser printer head that can be viewed externally through the bottom right corner of the top cover to obtain system status information without using an SI. Illumination of these lamps and the associated system status signaling are discussed in this document.
17. The LDR printer head will display fault codes even with the SI disconnected via a blue flashing LED. The fault code table for the flashing blue LED Fault Status Lamp gives the flash pattern and associated fault.

| Software Fault Code Name | Internal Code | Long Flashes | Short Flashes | Fault Description Text |
|---|---|---|---|---|
| ERR_CODE_FPGA | 0x0101 | 1 | 1 | FPGA mismatch error |
| ERR_CODE_INTERLOCK | 0x0201 | 2 | 1 | Interlock Fault |
| ERR_CODE_KEYSWITCH | 0x0202 | 2 | 2 | Arm Switch Fault |
| ERR_CODE_DC_POWER | 0x0203 | 2 | 3 | DC Power Fault |
| ERR_CODE_LASER_84V | 0x0204 | 2 | 4 | Laser 84V Loss |
| ERR_CODE_LASER_MOD | 0x0205 | 2 | 5 | Laser Modulation |
| ERR_CODE_DUTY_CYC | 0x0206 | 2 | 6 | Duty Cycle |
| ERR_CODE_LASER_RF | 0x0301 | 3 | 1 | Laser RF Fault |
| ERR_CODE_OVER_TEMP | 0x0302 | 3 | 2 | Over Temperature |
| ERR_CODE_VACUUM | 0x0303 | 3 | 3 | Vacuum Error |
| ERR_CODE_COOLANT | 0x0304 | 3 | 4 | Coolant Error |
| ERR_CODE_OVERLAP | 0x0305 | 3 | 5 | Mark Overlap |

***Table 1. Fault Code Table for Flashing Blue LED Fault Status Lamp***

In addition to the Fault Code Table above, the user Signal Interface Pin-Outs for connectors C1 and C2 located on the rear of the LDR laser head are detailed in Appendix A of this document.

The LDR Series of is the state-of-the-art in industrial digital laser printing. The user will want to check for updates and technical bulletins at the DPI website or from direct DPI technical support noted on the cover of this document.

### *Interface Hardware Requirements*

The interface hardware (PC, laptop, tablet or other GUI device) required to correctly and reliably operate the LDR is covered under a separate document “LDR Interface Hardware Requirements and Specifications”.

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## 1. USB LOGIN Screen

This screen appears first after communication is made between the Tablet/Android device and the LDR. This screen is at the top of the screen hierarchy at Level 1 (see Appendix A for the Software Screens Navigation Map).

**Screen Options:** The user may chose the default password which is blank (no entry) or set another one at the PASSWORDS Screen on Level 4. The arrow down buttons take the user to Level 2 after the correct Level 2 Password is entered.

## 2. SYSTEM STATUS Screen

This screen appears first after the USB LOGIN screen after the correct password is entered and the down arrow is activated in the USB LOGIN screen. This screen is at the top of the screen hierarchy at Level 2 and shows the status of the LDR printer.

**Screen Options:**

E. The System Idle status can be set to System Ready by toggling the Arming Switch on the Control Pendant to the "On" state (either "Off" >> "On" or "On" >> "Off" >> "On"). System Ready must be reset after any Critical Fault via correction of the fault condition and toggling of the Arming Switch.

F. In System Idle mode, the on-board green system status LED will blink continuously. In System Ready mode, the on-board green system status LED will be lit continuously.

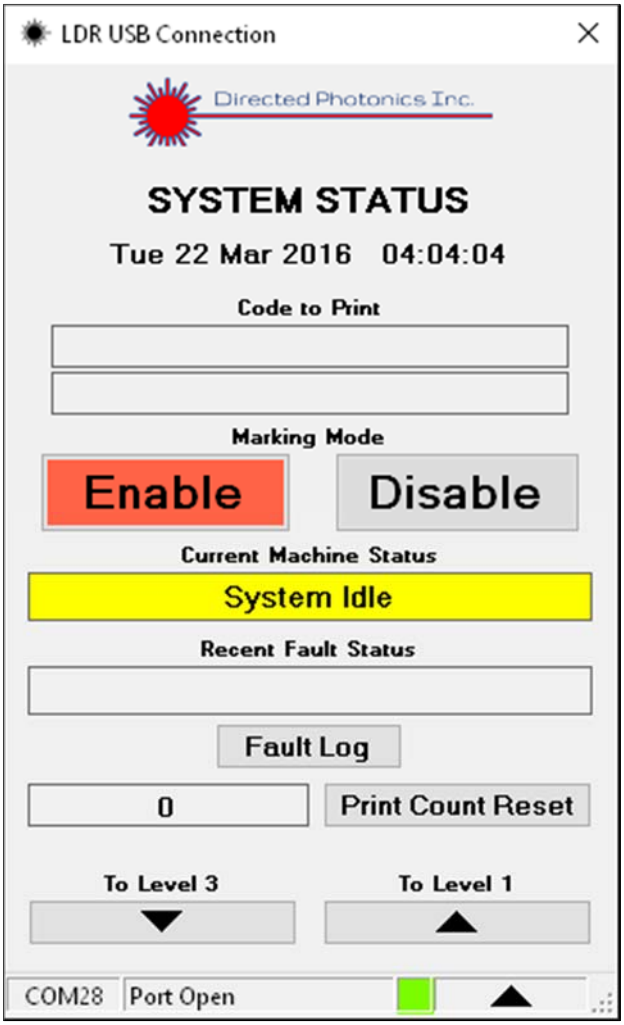
G. The code to be printed can be Enabled or Disabled here or via the Remote Mark Enable input. In print Enable mode "On", the on-board amber system status LED will turn "On" and the green Alarm Lamp will be lit. Also the red LED will turn on whenever the lasers are firing. They will also blink for five seconds after print Enable is turned "On" and if the Cold Start mode is turned "On" by the user.

H. The codes to be printed will be displayed in the Code to Print marquee boxes.

I. The Fault Log can be accessed where the history of any system faults can be viewed and/or reset.

J. The Print Count can be reset to "0".

K. Access to Level 1 or the SETUP LOGIN screen for Level 3 may be obtained.

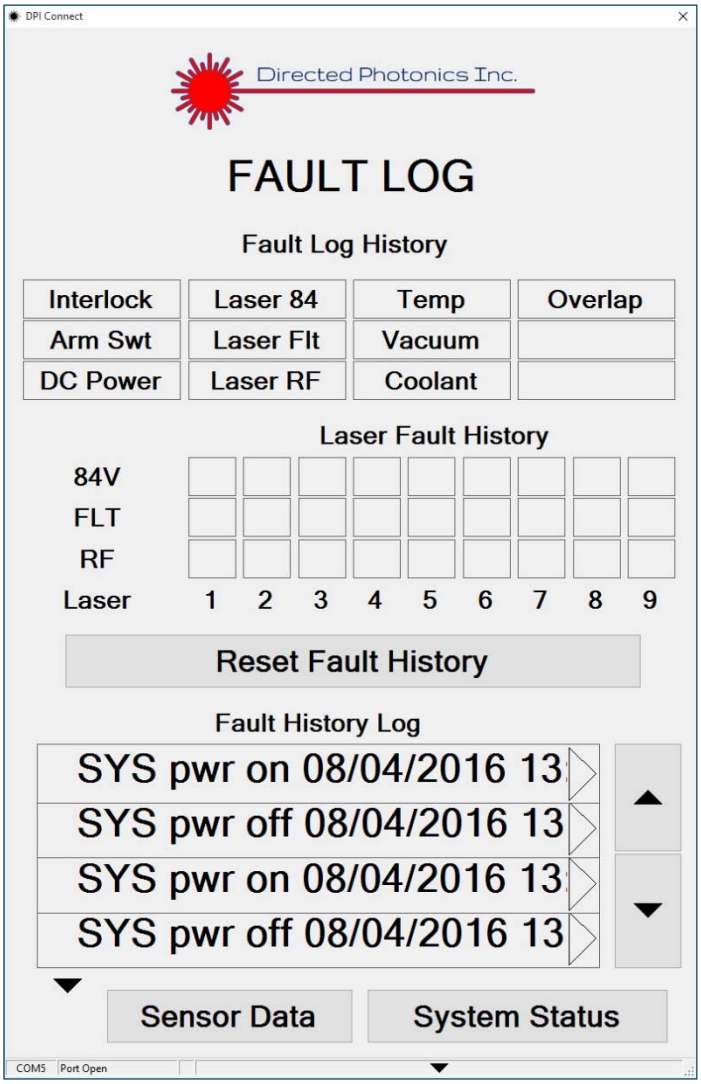


## 3. FAULT LOG Screen

This screen is only accessed from the SYSTEM STATUS screen and indicates the various possible faults that may be or have been detected. It is present at Level 2 of the screen hierarchy. Observed faults may be warnings (like Temp which indicates high system temperature) or hard faults shutting off printing (like Interlock which means the system interlock is activated and a safety fault condition is present).

**Screen Options:**

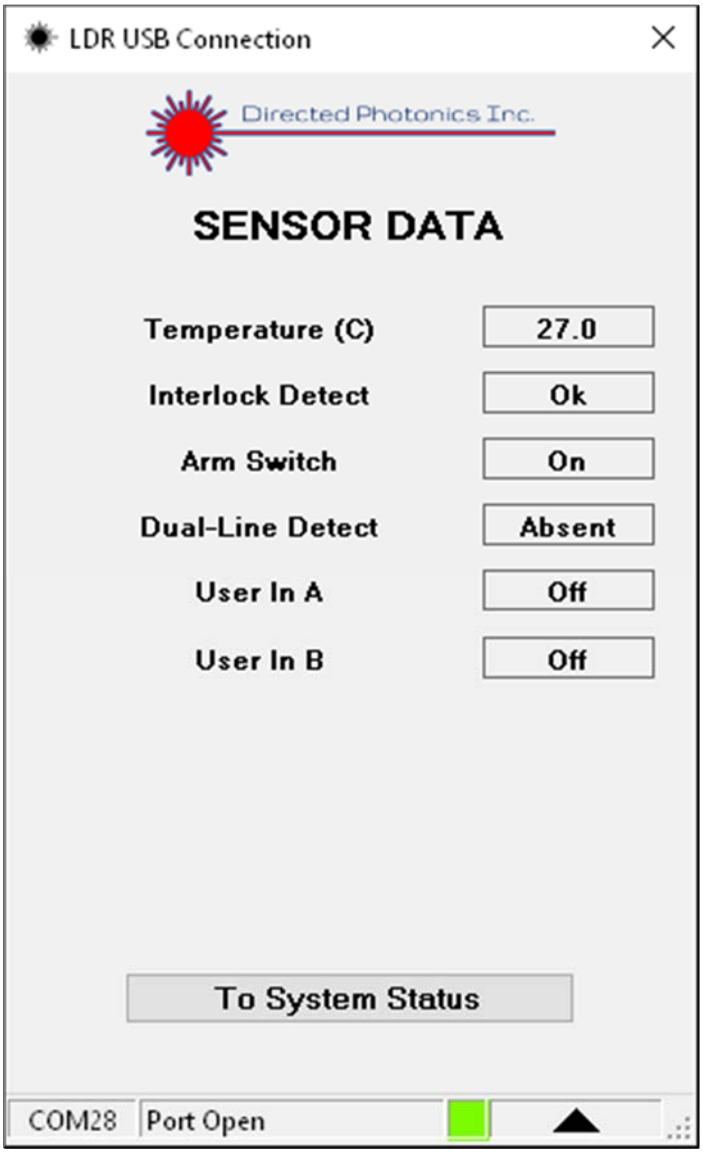
A. The Reset Fault History will clear the Laser Fault History and Fault Log History and stop illumination of the on-board amber and red system fault status LEDs. The Fault History Log cannot be cleared.
B. The Fault History Log can be scrolled with the Up and Down arrows.
C. The system Sensor Data can also be accessed from this screen.
D. The System Status screen can also be accessed from this screen.
E. In a Warning fault condition, the on-board amber system status LED will be lit continuously and the amber Alarm Lamp will be activated.
F. In a certain Critical Fault conditions, the on-board red system status LED will be lit continuously and the red Alarm Lamp will be lit continuously. The



## 4. SENSOR DATA Screen

This screen shows the status of the various system sensors. It is present at Level 2 of the screen hierarchy.

**Screen Options:** This screen indicates the states and values of various system parameters including the temperature of the control computer, status of the Interlock, status of the Arming Switch, the presence or absence of the Dual-Line attachment and the status of the two programmable User Inputs A and B. There are no user accessible options from this screen other than a return to the SYSTEM STATUS screen. This screen is strictly for informational purposes only and allows for no user inputs...



## 5. SETUP LOGIN Screen

This screen allows access to the Level 3 screens via entry of the correct password. The default password is blank but a fixed password may be set in the PASSWORD screen on Level 4. The arrow down must be activated after the Level 3 Password is entered. If the user entered Level 3 Password is blank then this screen will be skipped entirely.

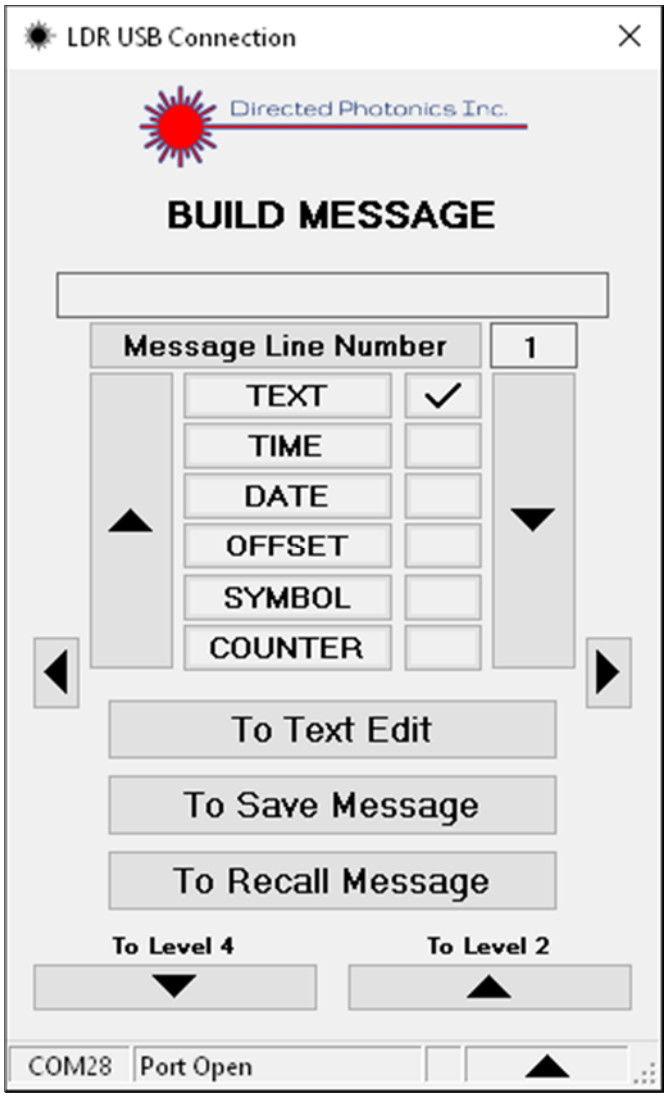
**Screen Options:** There are no user accessible options from this screen other than a return to the SYSTEM STATUS screen on Level 2.

## 6. BUILD MESSAGE Screen

This screen creates the messages to be printed. It is the primary "hub" screen for the entire LDR control software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. The Message Line Number can be chosen (1 or 2). Each message may contain one or two message lines. The 2nd message line only works with dual line printer attachment.
B. The TEXT, TIME, DATE, OFFSET, SYMBOL and COUNTER can be selected and placed in order of print using the up and down arrows. Coding for each of the six print options are chosen on other menus.
C. The TEXT EDIT, SAVE MESSAGE and RECALL MESSAGE screens are accessible from this menu.
D. Access to Levels 2 and 4 are also accessible from this menu without additional passwords for periods of time set by the user on Level 4.
E. The user may also scroll left or right on Level 3 using the arrow buttons.

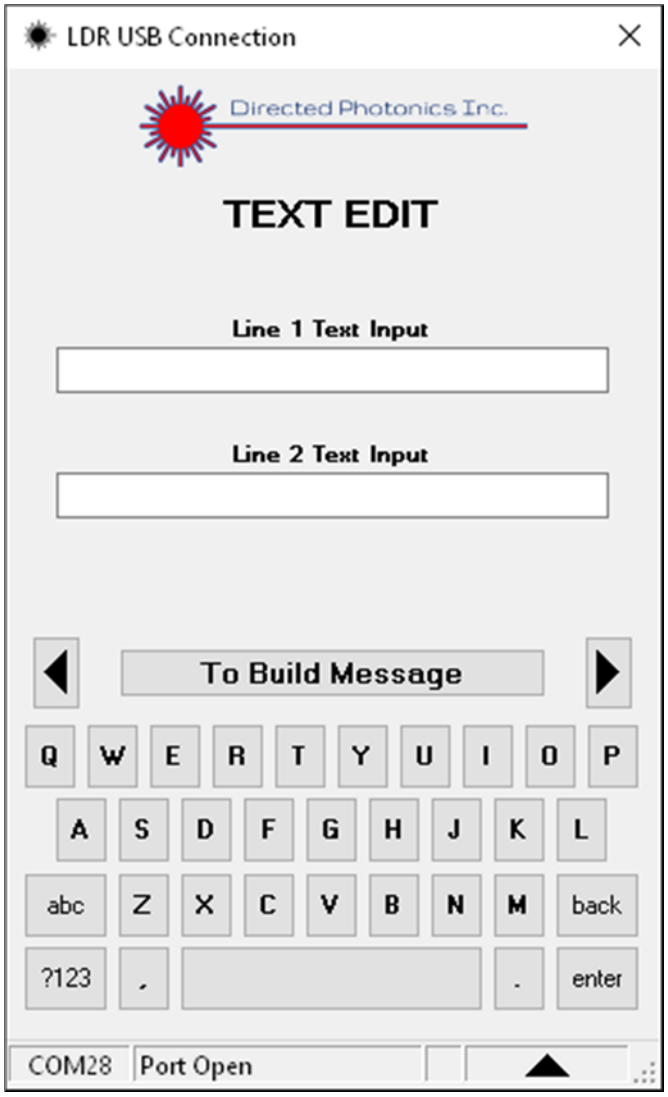


## 7. TEXT EDIT Screen

This screen is where the text inserts to be printed are created. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. Line 1 and or Line 2 ASCII text codes may be entered in the corresponding entry blocks with a maximum character length of 200 on each line.
B. The user may access the BUILD MESSAGE Screen.
C. The user may also scroll left or right on Level 3 using the arrow buttons.



## 8. SAVE MESSAGE Screen

This screen where the messages can be saved. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. A Message Name may be entered for the corresponding line 1 and Line 2 message entries with 1 being the default entry and 16 being the maximum entry.
B. A Message Number may be selected via up and down arrow scrolling.
C. The message is then saved by activating the Save Message button.
D. Access to the BUILD MESSAGE screen is also available to the user.
E. The user may also scroll left or right on Level 3 using the arrow buttons.

## 9. RECALL MESSAGE Screen

This screen is where the messages can be recalled. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

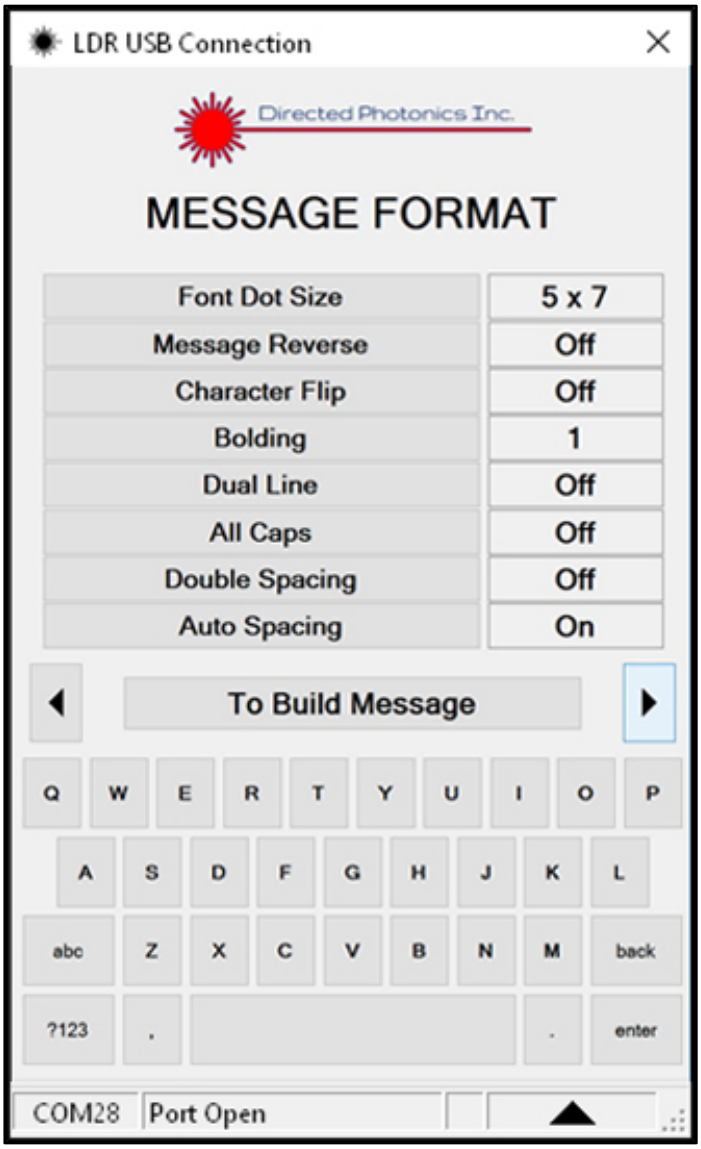
A. A Message Name may be entered for the corresponding line 1 and Line 2 message entries with 1 being the default entry and 16 being the maximum entry.
B. A Message Number may be selected via up and down arrow scrolling.
C. The message is then recalled by activating the Recall Message button.
D. Access to the BUILD MESSAGE screen is also available to the user.
E. The user may also scroll left or right on Level 3 using the arrow buttons.

## 10. MESSAGE FORMAT Screen

This screen allows for messages to be formatted. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. Font Dot Size of 5X5, 5X7, 6X7, 9X7 and Hi Res can be selected by toggling the entry key. For the Hi Res option, the Hi Res lens hardware option must be installed.
B. The user entries Message Reverse, Character Flip, All Caps, Double Spacing and Auto Spacing can each be toggled to the “On” or “Off” state.
C. Dual Line can be toggled among the settings “Off”, “Left”, “Center” or “Right” (for print justification).
D. Bolding can be toggled among the values 1, 2, 3 and 4 with 1 being the default value.
E. Figure below shows all the default values for this screen.
F. Access to the BUILD MESSAGE screen is also available to the user.
G. The user may also scroll left or right on Level 3 using the arrow buttons.

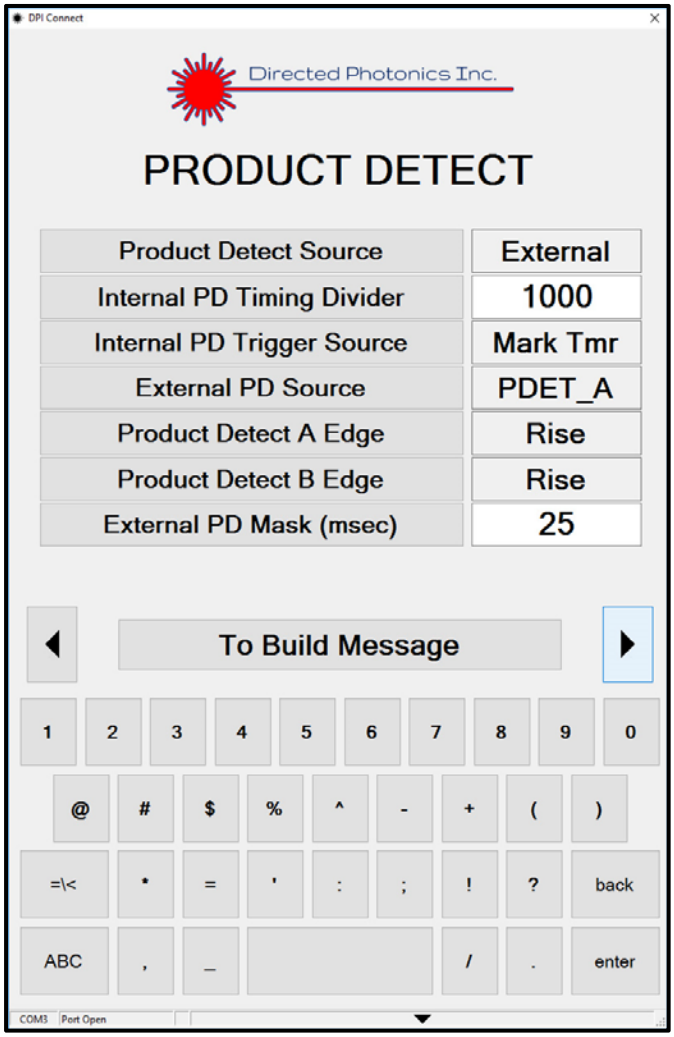


## 11. PRODUCT DETECT Screen

This is the screen where the print activation signal (the “Print Go”) is generated. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. The Product Detect Source can be toggled to the “On” or “Off” state.
B. The Internal PD Timing Divider can be set between 5 and 10000.
C. The Internal PD Trigger Source can be toggled among the settings Mark Tmr (mark timer), Enc Quad (quadrature encoder), Enc-A (encoder channel A) and Internal.
D. External PD Source user selections are PDET-A (product detect channel A) or PDET-B (product detect channel B).
E. Product Detect A Edge and Product Detect B Edge can be both toggled to Rise or Fall.
F. External PD Mask (msec) can be set to ignore noise for a set time after an External Product Detect.
G. Figure below shows all the default values for this screen.
H. Access to the BUILD MESSAGE screen is also available to the user.
I. The user may also scroll left or right on Level 3 using the arrow buttons.

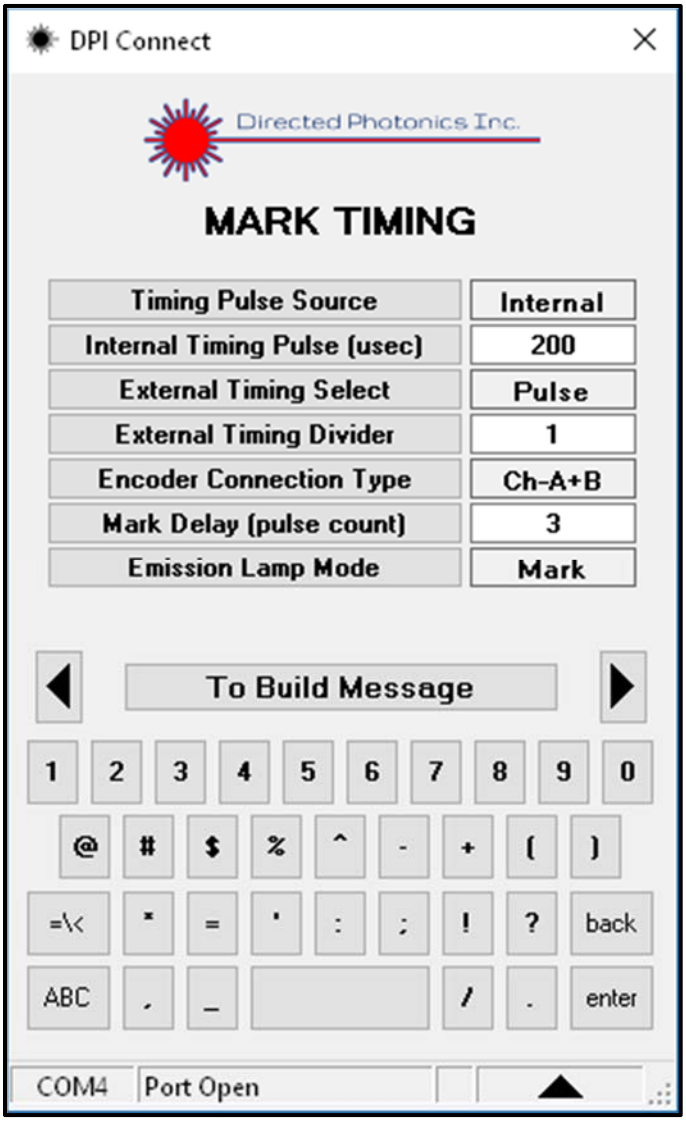


## 12. MARK TIMING Screen

This screen where the print timing signal (the “Print Pulse”) is generated. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. The Timing Pulse Source can be toggled to the Internal or External state.
B. The Internal Timing Pulse can be set between 5 and 5000.
C. The External Timing Select can be toggled between Pulse and Quad (quadrature).
D. The External Timing Divider can be set between 1 and 65535.
E. The Encoder Connection Type can be toggled between CH A+B or CH-A.
F. Mark Delay (pulse count) can set between 3 and 10000.
G. Emission Lamp Mode can be set for Pulse (1 second on time) or Mark (on for the mark length only)
H. Figure below shows all the default values for this screen.
I. Access to the BUILD MESSAGE screen is also available to the user.
J. The user may also scroll left or right on Level 3 using the arrow buttons.

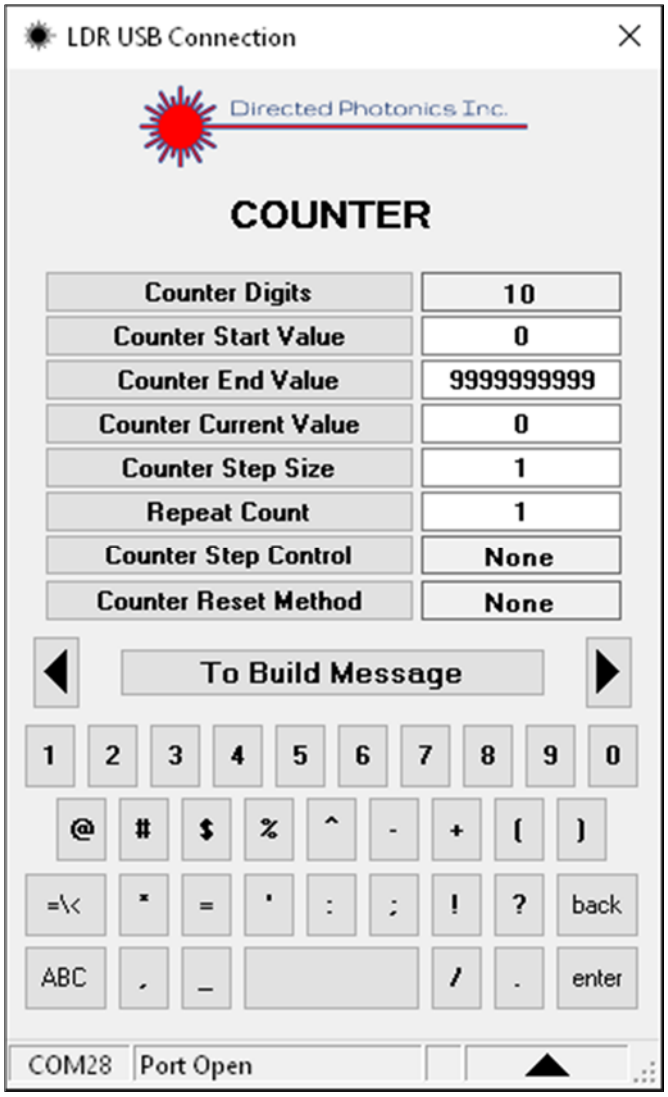


## 13. COUNTER Screen

This screen allows the user to sequentially mark products. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. The Counter Digits can be set between 1 and 10 (where the choice of the number 4 yields a maximum count of 9999 before resetting).
B. The Counter Start Value can be set to any value between 0 and 9999999999.
C. The Counter End Value can be set to any value between 0 and 9999999999.
D. The Counter Current Value can be reset to any value between 0 and 9999999999.
E. The Counter Step Size can be set to any value between 0 and 9999.
F. The Repeat Count can be set to any value between 0 and 1000.
G. Counter Step Control can be toggled among None, Prod Det, User In A+/A-, and User In B+/B-.
H. Counter Reset Method can be toggled between None, User In A+/A-, and User In B+/B-.
I. Figure below shows all the default values for this screen.
J. Access to the BUILD MESSAGE screen is also available to the user.
K. The user may also scroll left or right on Level 3 using the arrow buttons.

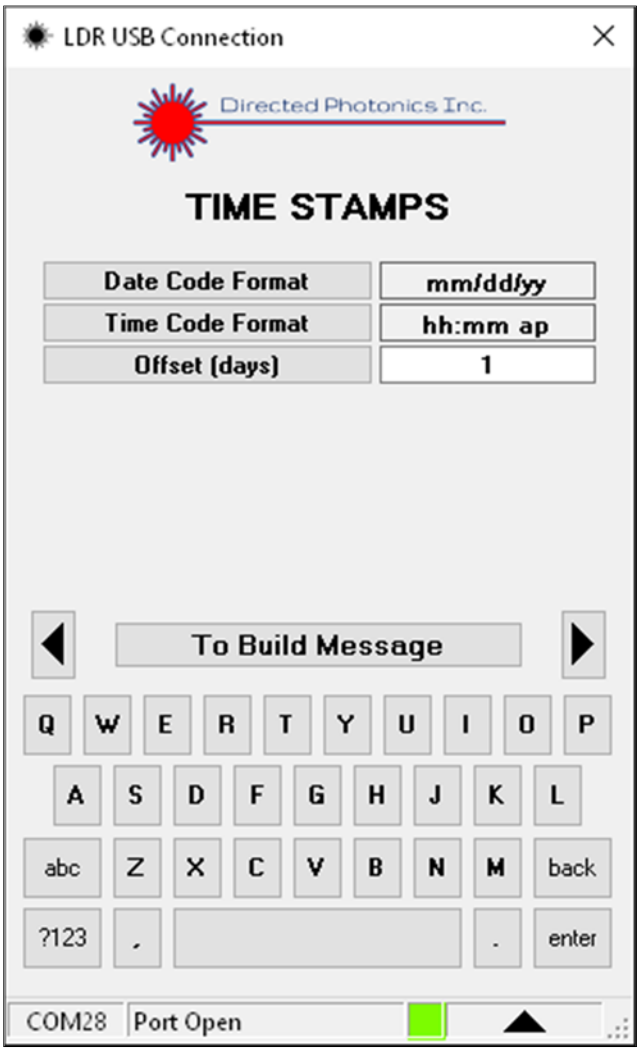


## 14. TIME STAMPS Screen

This screen is where the time to be marked is set. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. The Date Code Format can be toggled among the settings mm/dd/yy, dd-mmm-yy, ddmmyy, jjj (for Julian date), yjjj (for single digit year plus Julian date) and yyjjj (for dual digit year plus Julian date).
B. The Time Code Format can be toggled among the settings hh:mm, HH:mm or Qtr Code (15 minute daily increments between 0 and 96).
C. The Offset (days) is user adjustable between 0 and 10000 (the number of days to offset from the current date).
D. Figure below shows all the default values for this screen.
E. Access to the BUILD MESSAGE screen is also available to the user.
F. The user may also scroll left or right on Level 3 using the arrow buttons.

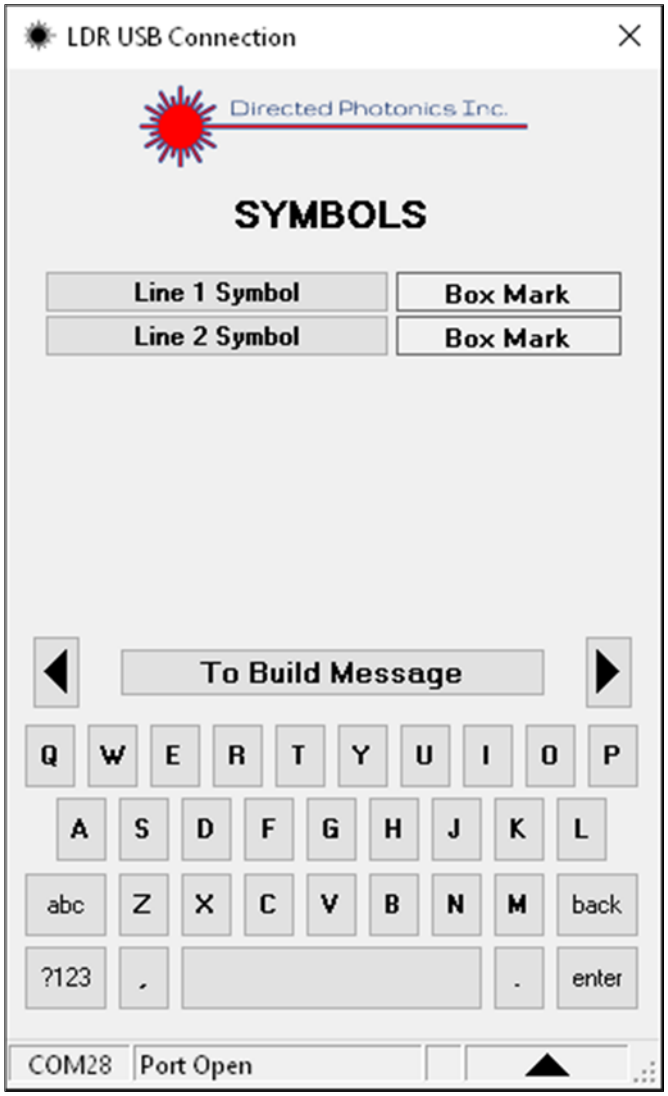


## 15. SYMBOLS Screen

This screen is where the user defined Symbol to be marked is selected. It is a supporting screen for the LDR message build software and it is present at Level 3 of the screen hierarchy.

**Screen Options:**

A. The Line 1 and Line 2 Symbols are selectable by toggling the corresponding keys.
B. Current symbol selections programmed into the LDR are Box Mark, Left Wall, Right Wall and Checker Board.
C. Figure below shows all the default values for this screen.
D. Access to the BUILD MESSAGE screen is also available to the user.
E. Assistance with programming the symbols is available from DPI Technical Support.
F. The user may also scroll left or right on Level 3 using the arrow buttons.

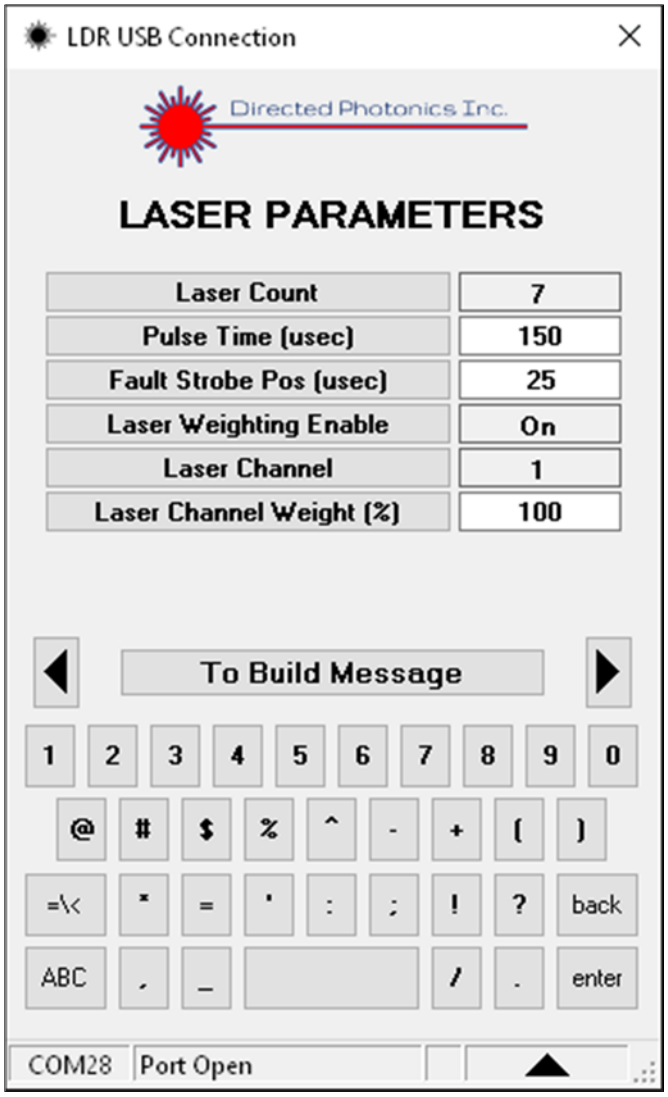


## 16. LASER PARAMETERS Screen

This screen is where the parameters for laser operation are set. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. The Laser Count may be toggled among the values 5, 7 and 9.
B. The Pulse Time (usec) may be set between 10 and 500.
C. The Fault Strobe Position (usec) is adjustable between 25 and 50 but the user is advised to use the default value of 25.
D. Laser Weighting may be toggled between the “On” and “Off” settings.
E. Laser Channel may be toggled from 1 to 9 and selects the laser channel to be weighted.
F. Laser Channel Weight (%) may be set between 50 and 150 and allows more or less power per laser channel selected.
G. Figure below shows all the default values for this screen.
H. Access to the BUILD MESSAGE screen is also available to the user.
I. The user may also scroll left or right on Level 4 using the arrow buttons.



## 17. REAL TIME CLOCK Screen

This screen is where the parameters for the clock time are set. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. The Time (hhmmss) can be set by the user to any value between 000000 and 235959.
B. The Date (mmddyy) can be set by the user to any value between 010100 and 123199.
C. The Set Time/Date to Clock fixes the adjusted settings above to the LDR clock.
D. Figure below shows all the default values for this screen.
E. Access to the BUILD MESSAGE screen is also available to the user.
F. The user may also scroll left or right on Level 4 using the arrow buttons.

## 18. GENERAL SETUP Screen

This screen is where two key operating parameters for the LDR are generated. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy. Here the User can set two important LDR control parameters one of which allows the user to reactivate the LDR after a critical fault stoppage by simply activating the arming switch without the need of using the control screens of the tablet or Smartphone Android APP.

**Screen Options:**

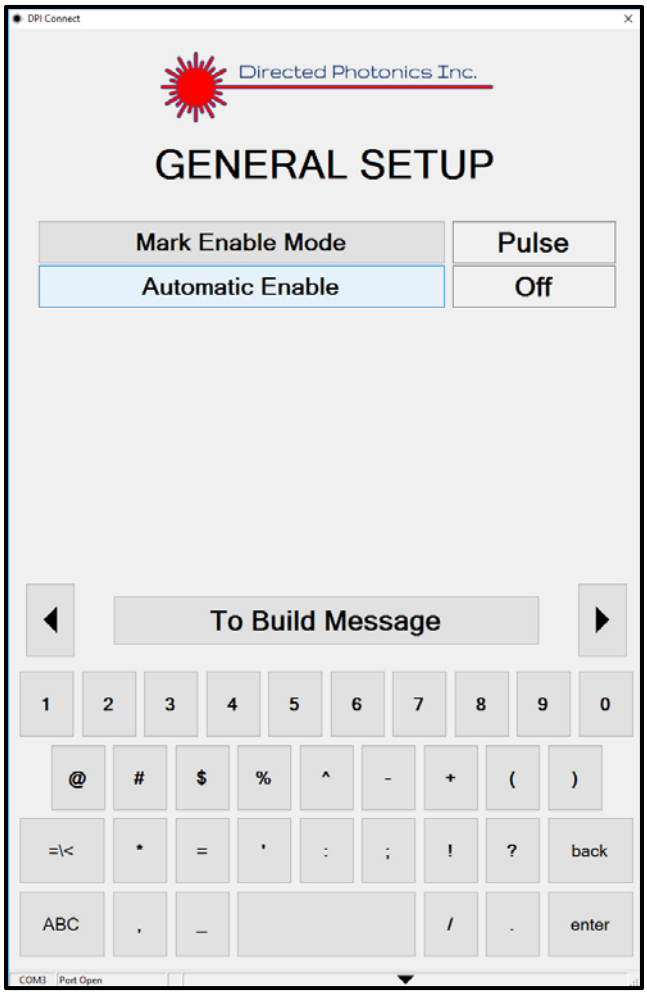
A. The Mark Enable Mode sets the way in which the LDR detects a mark enable input. The two states are “Pulse” and “Level”. In Pulse mode the LDR will trigger a mark enable if a rising or falling pulse is detected on the selected product detect input. In Level mode the LDR will trigger a mark enable if a fixed positive voltage is present on the selected product detect input.

B. The Automatic Enable sets the method by which the LDR is reset to Mark Enable “On” after a critical fault. When set to “On”, the LDR can be reset to Mark Enable “On” by just toggling the Arming Switch. The “On” setting bypasses a protection level so it is set to “Off” by default.

C. Figure below shows all the default values for this screen.

J. Access to the BUILD MESSAGE screen is also available to the user.

K. The user may also scroll left or right on Level 4 using the arrow buttons.

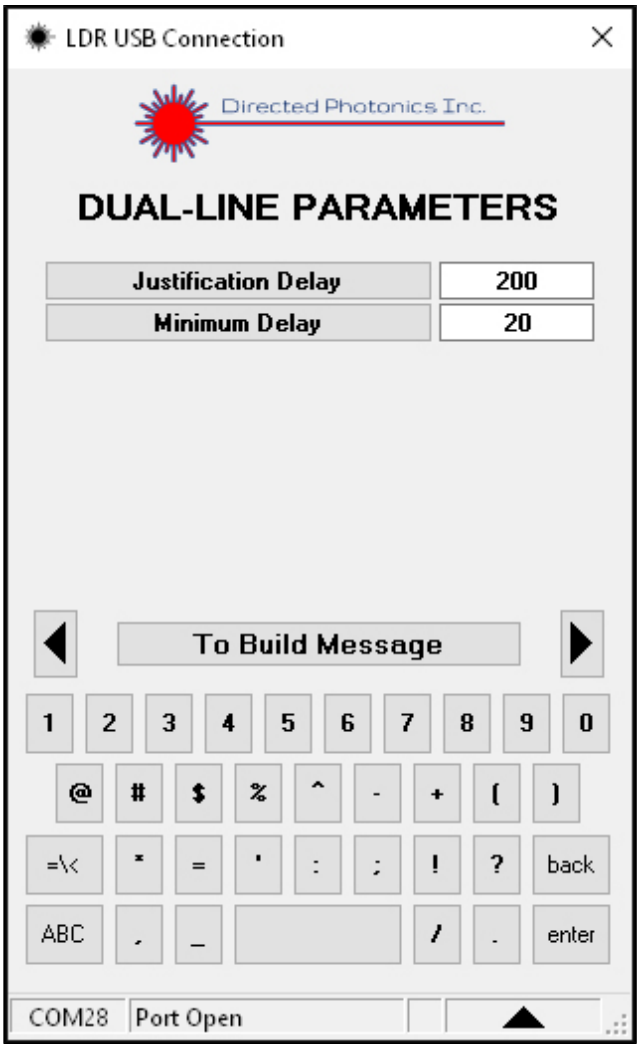


## 19. DUAL LINE Screen

This screen is where the parameters for the dual line codes are generated. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy. It is only active when the dual line attachment is detected by the LDR system.

**Screen Options:**

D. The Justification Delay is counted in timing pulses and is user adjustable between 10 and 1000.
E. The Minimum Delay is counted in timing pulses and is user adjustable between 10 and 100.
F. Figure below shows all the default values for this screen.
L. Access to the BUILD MESSAGE screen is also available to the user.
M. The user may also scroll left or right on Level 4 using the arrow buttons.

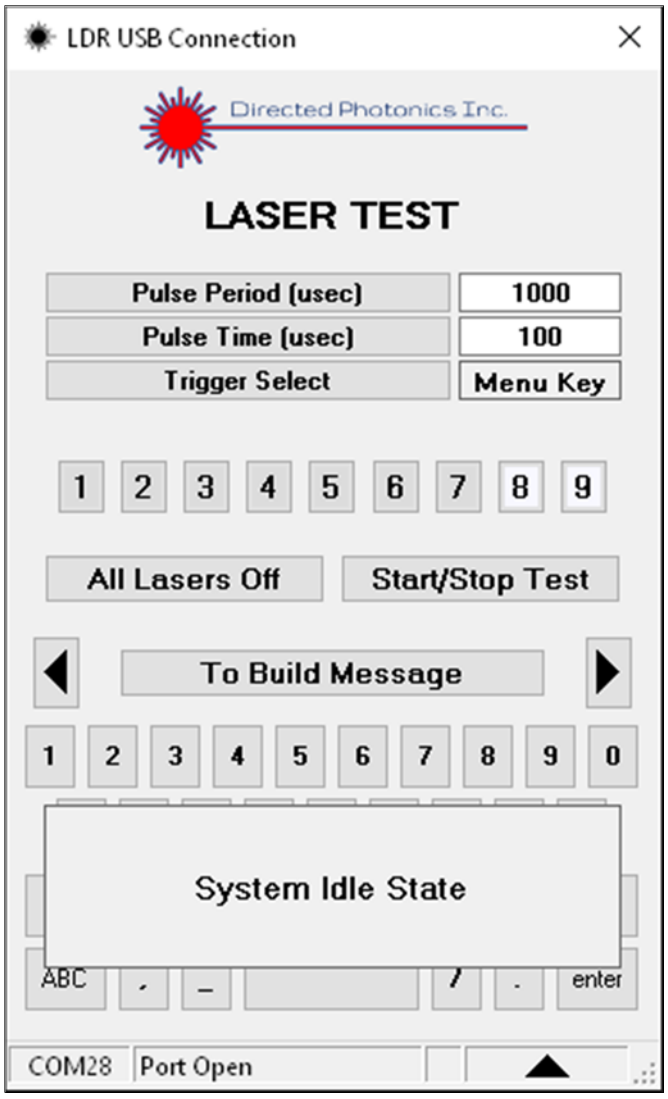


## 20. LASER TEST Screen

This screen is where the parameters for laser testing are set. It is primarily a troubleshooting tool. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. The Pulse Period (usec) is user adjustable between 500 and 1000 (the time between laser pulses).
B. The Pulse Time (usec) is user adjustable between 50 and 150 (the laser on pulse time).
C. Trigger Select may be toggled by the user among the settings Menu Key, User In A or User In B.
D. One or more lasers can be selected for testing by the buttons labeled 1 to 9.
E. The All Lasers Off button turns off all the lasers being tested.
F. The Start/Stop Test button is the Menu Key that turns the laser test “On” and “Off”.
G. Figure below shows all the default values for this screen.
H. Access to the BUILD MESSAGE screen is also available to the user.
I. The user may also scroll left or right on Level 4 using the arrow buttons.

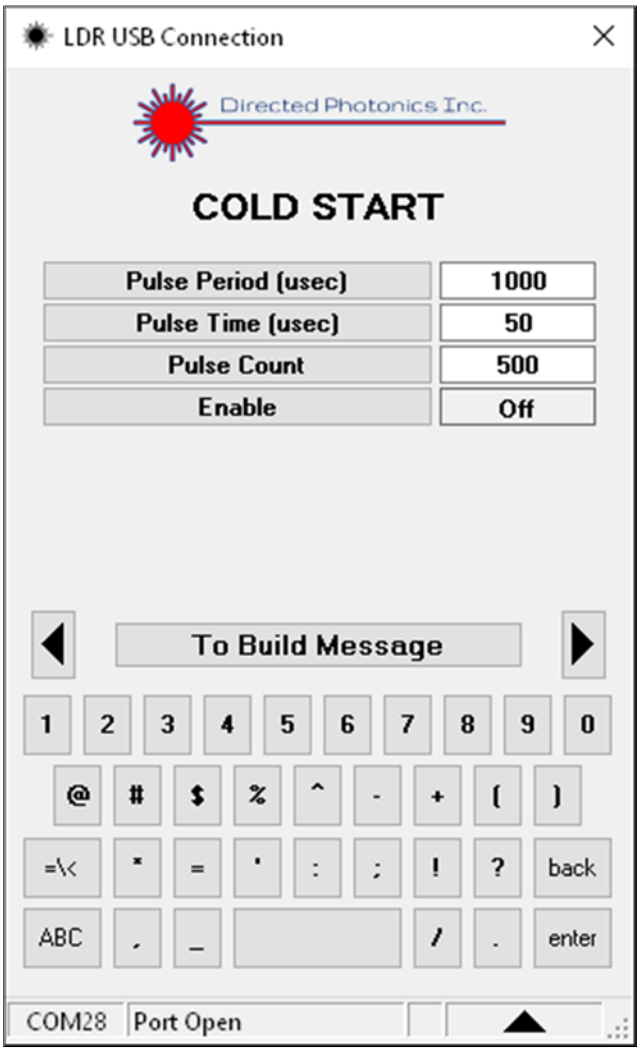


## 21. COLD START Screen

This screen is where the parameters for cold start are set. It is primarily a system initialization sequence that fires the lasers for a brief period to optimize performance 5 seconds after initiating ENABLE on the SYSTEM STATUS screen. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. The Pulse Period (usec) is user adjustable between 10 and 1000 (the time between laser pulses).
B. The Pulse Time (usec) is user adjustable between 20 and 50 (the laser on pulse time).
C. Pulse Count is user adjustable between 100 and 1000.
D. Enable may be toggled between “On” and “Off” (Default is “On”).
E. Figure below shows all the default values for this screen.
F. Access to the BUILD MESSAGE screen is also available to the user.
G. The user may also scroll left or right on Level 4 using the arrow buttons.



## 22. USER OUTPUT Screen

This screen is where the parameters for the two user outputs (A and B) are set. It provides the user a limited set of programmable output signals dependent on the user's settings. These signals may be used to control ancillary equipment such as compressed air or water cooling supplies among others. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. The User Out A Config may be set at one of six settings which include None, Sys Ready, Print Enab, Crit Fault, Any Fault and Print Plse.
B. The User Out B Config may be set at one of six settings which include None, Sys Ready, Print Enab, Crit Fault, Any Fault and Print Plse.
C. The choice of system trigger state causes the output line to go and stay low and sink up to 500 mA of current. The Print Plse = "print mark has finished" option sets the User Output to go low and sink 500 mA for 1 to 2 msec with pulsewidth dependent on the laser mark parameters.
D. The User Output states are activated when the following system state(s) exist: Sys Ready = system in ready, Print Enab = print enabled, Crit Fault = critical fault present, Any Fault = any fault present and Print Plse = printing of last mark completed. The fault options are state-checked every .01 sec.
E. Figure below shows the default values for this screen.
F. Access to the BUILD MESSAGE screen is also available to the user.
G. The user may also scroll left or right on Level 4 using the arrow buttons.

## 23. SIGNAL FILTERS Screen

This screen is where the filtering parameters for the system external inputs are set. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

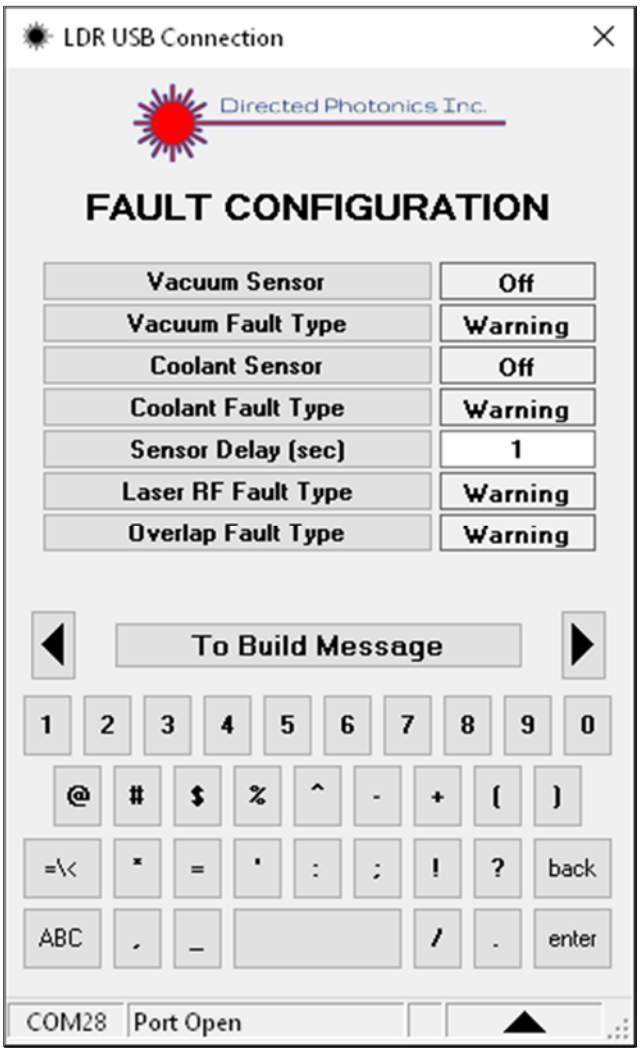
A. The user selectable inputs for all option are “On” or “Off”.
B. The filters that are adjustable are self-explanatory by their descriptions.
C. It is recommended that the user not change the default settings.
D. Figure below shows all the default values for this screen.
E. Access to the BUILD MESSAGE screen is also available to the user.
F. The user may also scroll left or right on Level 4 using the arrow buttons.

## 24. FAULT CONFIGURATION Screen

This screen is where the fault severity selections are set. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. The Vacuum Sensor and Coolant Sensor inputs may both be toggled “On”/”Off” by the user among the settings Off, User In A or User In B.
B. The Vacuum Fault Type and Coolant Fault Type may both be toggled “On”/”Off” by the user between the settings Warning and Critical.
C. The Coolant Sensor Delay (sec) may be set by the user between 1 and 30.
D. The Laser RF Fault Type and Overlap Fault Type may be toggled by the user between the settings Warning and Critical.
E. It is recommended that the user not change the default settings.
F. Figure below shows all the default values for this screen.
G. Access to the BUILD MESSAGE screen is also available to the user.
H. The user may also scroll left or right on Level 4 using the arrow buttons.
I. In a Warning fault condition, the on-board amber system status LED will be lit continuously.
J. In a Critical fault condition, the on-board red system status LED will be lit continuously.

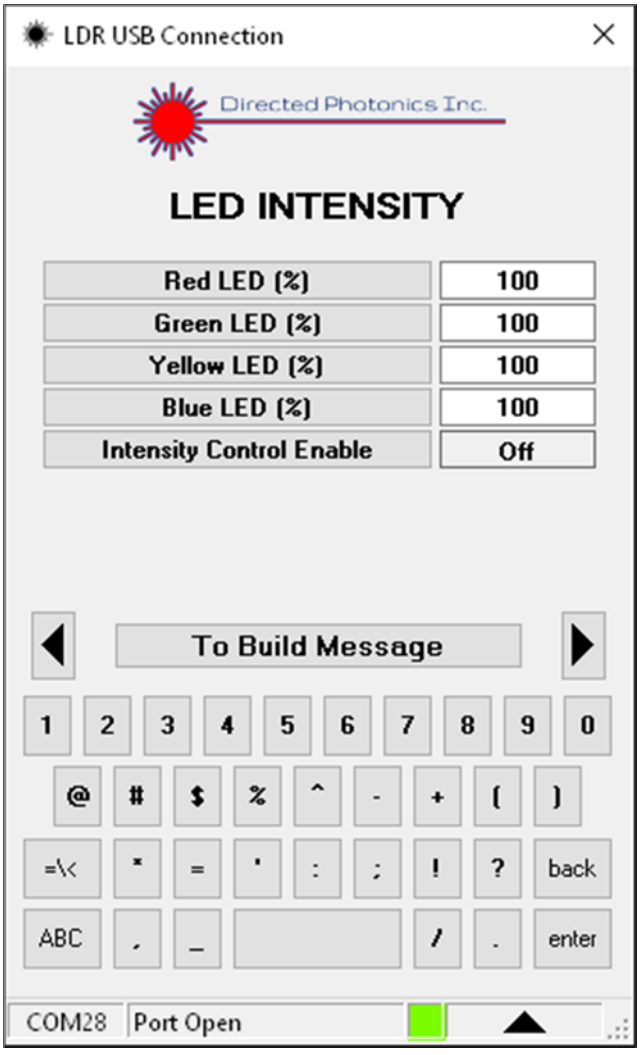


## 25. LED INTENSITY Screen

This screen is where the intensity of the LDR print head LEDs are set. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy. The adjustments are used to compensate for ambient lighting conditions.

**Screen Options:**

A. The four (4) LED % selections can all be set by the user between 1 and 100.
B. The Intensity Control Enable may be toggled between “On” and “Off”.
C. It is recommended that the user not change the default settings.
D. Figure below shows all the default values for this screen.
E. Access to the BUILD MESSAGE screen is also available to the user.
F. The user may also scroll left or right on Level 4 using the arrow buttons.



## 26. PASSWORDS Screen

This screen is where the passwords for the various screen levels selections are set. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

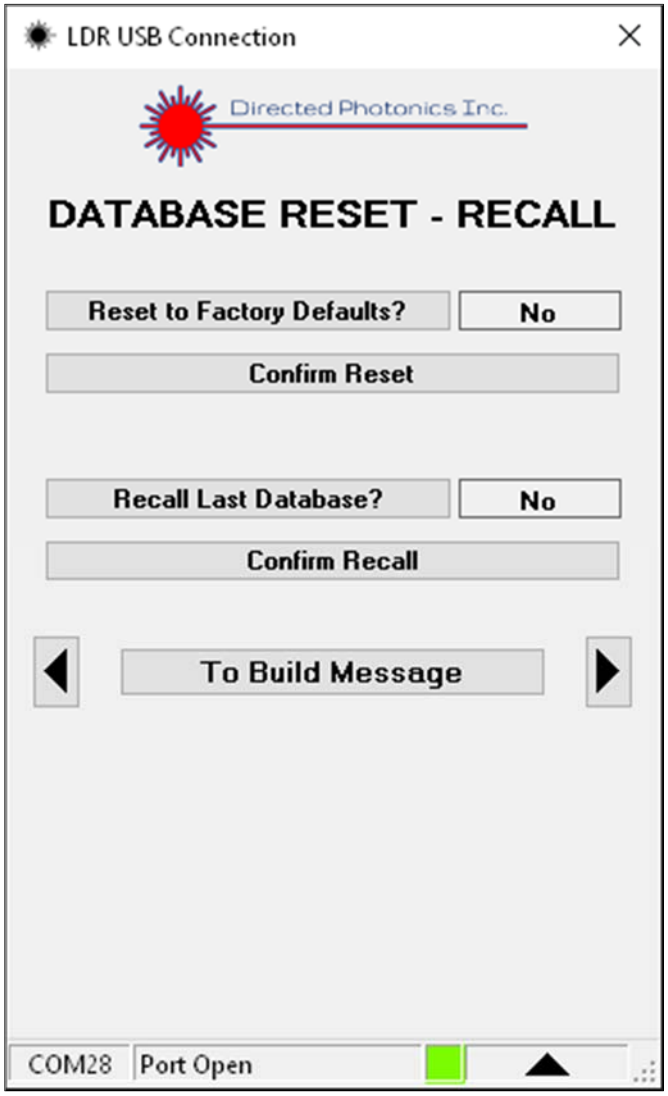
A. The Login Password (for Level 2 entry) and the Setup Password (for Level 3 and 4 entry may be set by the user.
B. The password Bypass Time (min) can be set by the user between 1 and 60 and is the number of minutes the user can stay at Levels 3 and 4 before having to re-enter the Setup Password.
C. Figure below shows the default values for this screen.
D. Access to the BUILD MESSAGE screen is also available to the user.
E. The user may also scroll left or right on Level 4 using the arrow buttons.

## 27. DATABASE RESET-RECALL Screen

This screen is where the entire LDR database can be reset to the original factory defaults or can be set to a prior saved database. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. The user can choose to Reset to Factory Defaults via a toggle of the Yes/No button and then confirm with activation on the Confirm Reset key.
B. The user can choose to Recall Last Database via a toggle of the Yes/No button and then confirm with activation on the Confirm Recall key.
C. It is recommended that the user not change the LDR database before thoroughly reviewing all other options.
D. Figure below shows all the default values for this screen.
E. Access to the BUILD MESSAGE screen is also available to the user.
F. The user may also scroll left or right on Level 4 using the arrow buttons.

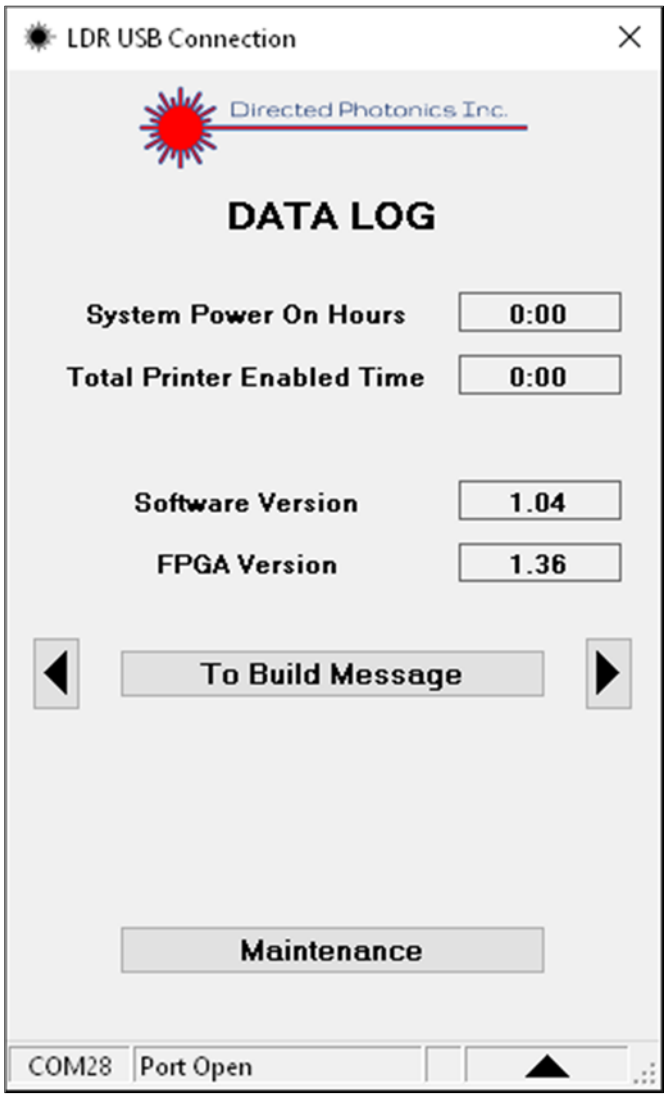


## 28. DATA LOG Screen

This screen is where the operational time of the LDR is recorded and the software and FPGA versions are noted. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy.

**Screen Options:**

A. There are no user adjustable inputs on this screen.
B. Access to the BUILD MESSAGE and MAINTENANCE screens are also available to the user.
C. The user may also scroll left or right on Level 4 using the arrow buttons.



## 29. MAINTENANCE LOGIN Screen

This screen is where access to the core maintenance parameters is made possible. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy. The password for this screen is not available to the user.

**Screen Options:**

A. There are no user adjustable inputs on this screen. The Maintenance Password is a DPI-protected parameter.
B. Access to the DATA LOG screen is also available to the user.

## 30. MAINTENANCE Screen

This screen is where access to the reset of the LDR running time is made possible. It is a supporting screen for the LDR message build software and it is present at Level 4 of the screen hierarchy. The password for this screen is not available to the user.

**Screen Options:**

A. There are no user adjustable inputs on this screen.
B. Access to the BUILD MESSAGE screen is also available to the user.
C. The user may also scroll left or right on Level 4 using the arrow buttons.

# Appendix A: 25-Pin (C1) and 9-Pin (C2) Interface Signal Pin-Outs

### *Overview*

The LDR Series of digital carbon dioxide laser printers are designed to interface with a various industrial product instrumentation such as product detectors, speed encoders, alarm lamps, interlocks etc. The LDR software both controls output signals and uses input signals via these two connectors to allow the user to command LDR timing and function. The tables below list the pin-out for the various signals of the two interface connectors designated as C1 and C2. All outputs are current limited (500 mA) pull-down circuits and all inputs are +12V drive circuits.

| 25-Pin Connector Pinouts | | |
|---|---|---|
| **Pin #** | **Function** | **Comments** |
| 1 | +12 VDC | To power detector |
| 2 | Product Detector Input "A" | |
| 3 | Product Detector Input "B" | |
| 4 | Ground | Ground for detectors “A” and “B” |
| 5 | +12 VDC | To power encoders |
| 6 | Shaft Encoder Input "A+" | |
| 7 | Shaft Encoder Input "A-" | |
| 8 | Shaft Encoder Input "B" | |
| 9 | Shaft Encoder Input "B-" | |
| 10 | Ground | Ground for encoder "A" |
| 11 | Ground | Ground for encoder "B" |
| 12 | +12 VDC | To power user I/O |
| 13 | User Output "A" | |
| 14 | User Output "B" | |
| 15 | User Input "A" | |
| 16 | User Input "B" | |
| 17 | User I/O Return Ground | Ground for User I/O "A" |
| 18 | User I/O Return Ground | Ground for User I/O "B" |
| 19 | Remote Mark Enable Input | +5V to +36V |
| 20 | Ground | Ground for remote mark enable |
| 21 | +12 VDC | To power indicators |
| 22 | Mark Enable Indicator Output | |
| 23 | Emission Indicator Output | |
| 24 | Ground | Spare ground |
| 25 | Shield Ground | Charge Drain for PDET & ENC |
| | | |
| Note: | All outputs buffered 500 mA @ 12 V | |

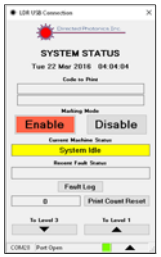
**Table 2. 25-Pin LDR Interface (C1) Signal Pin-Outs**

| 9-Pin Connector Pinouts | | |
|---|---|---|
| Pin # | Function | Comments |
| 1 | +12 VDC | Spare +12 VDC |
| 2 | Red Alarm Output | |
| 3 | Amber Alarm Output | |
| 4 | Green Alarm Output | |
| 5 | Ground | Ground for alarms |
| 6 | Interlock Enable Output | |
| 7 | Interlock Return Ground | |
| 8 | +12 VDC | Spare +12 VDC |
| 9 | Ground | Spare ground |
| | | |
| Note: | All outputs buffered 500 mA @ 12 V | |

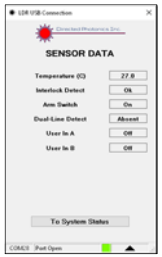
**Table 3. 9-Pin LDR Interface (C2) Signal Pin-Outs**

# Appendix B: Software Screens Navigation Map


LEVEL 1









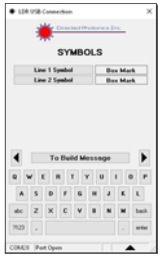
LEVEL 2







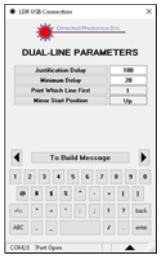
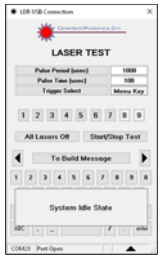


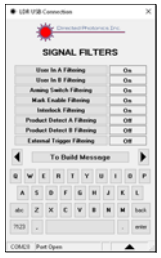

LEVEL 3

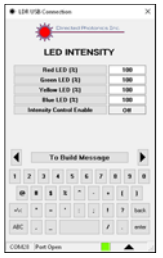

LASER PARAMETERS

REAL TIME CLOCK

GENERAL SETUP

DUAL-LINE PARAMETERS

LASER TEST

COLD START

USER OUTPUTS

SIGNAL FILTERS

FAULT CONFIGURATION

LED INTENSITY

LEVEL 4>>


PASSWORDS

DATABASE RESET - RECALL

DATA LOG

MAINTENANCE LOGIN

MAINTENANCE

<<END>>