

Photronics Industries
International, Inc.

**MODEL DP20 PULSE PUMPED LASER
INSTALLATION AND OPERATION MANUAL**

(Revised December 2011)

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Warning! Read this manual carefully before you start the installation of the laser.

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PREFACE

This manual contains general user information for the model DP Series laser. General information contained is applicable to both fundamental IR lasers and Harmonic lasers operating at the shorter wavelengths. For specific laser system information, or system parameters, refer to data sheet supplied with the laser system.

The DP Series laser is an OEM product designed for incorporation into other equipment. Accordingly, the device has not been certified by CDRH and is to be used only as a component within other devices. The user is responsible for CDRH certification and/or other regulatory issues in the location and use. Below are two specific symbols that are used throughout the manual. Please note and read carefully all of the places that they are used. All of the features and specifications of the DP Series laser are subject to change without notice.



This symbol is intended to alert the operator to the danger of exposure to hazardous Visible, Invisible, or Ultra Violet radiation.



This symbol is intended to alert the operator to the potential danger to the operator or equipment, or to give the operator important instructions.

1. LASER SAFETY



DANGER! The DP Series laser has Emission at a level of Class IV. Extreme care should be used during operation. The output beam could be a fire and safety hazard. Only personnel that are familiar with the safety precautions listed in this manual should attempt to operate the laser system. Precautions must be taken to prevent accidental exposure to direct or reflected beams. Both diffuse and specular reflections can cause severe skin or eye damage. Proper eyewear must be worn at all times.

Safe Operation of Class IV lasers.

1. Keep the laser cover in place at all times.
2. Avoid looking at the output beam. Specular and diffuse reflections are hazardous.
3. Avoid wearing jewelry when using the laser.
4. Use laser safety eyewear that is optically dense at the wavelengths of operation being used as a precaution against accidental exposure to the output beam or its reflection.
5. Use an IR detector card to verify that the laser beam is OFF for safety.
6. Set up non-reflective beam stops to block the output of reflected beams.
7. Whenever possible, use some type of enclosure for beam paths.
8. Set up your work process in such a manner that the laser beam is not at eye level.

9. Post warning-signs near the laser operation area for Class IV laser products.
10. Set up an access zone around the laser area using safety interlocks to prevent inexperienced personnel from freely entering into the laser working area.

Because of its special properties, laser light poses safety hazards not associated with light from conventional light sources. The safe use of a laser requires that all laser users, and everyone near the laser system, are aware of the dangers associated with the use of this type of system. The safe use of the laser depends upon the user being familiar with the instrument and the properties of coherent, intense beams of light.



DANGER! Direct eye contact with the output beam from the laser will cause serious damage and possible blindness.

The greatest danger when using a laser is eye safety. In addition to the main beam, there are often many smaller beams present at various angles near the laser system. These beams are formed by specular reflections of the main beam at polished surfaces such as lenses, mirrors and other optics. While these beams are weaker than the main beam, they may still be sufficiently intense enough to cause eye damage.

Laser beams are powerful enough to burn skin, clothing or paint. Even at some distance, they can ignite volatile substances such as solvents. The laser beam can damage light sensitive elements in video cameras and photo-diodes. The laser beam may also cause damage if contacted indirectly from some reflective surface. The user is advised to follow the precautions below and in this manual.

1. Observe all safety precautions in this manual.
2. Extreme caution should be used when using volatile substances in the laser area.
3. Limit the access of the laser to qualified users who are familiar with laser safety practices and who are aware of the dangers involved.
4. Never look directly into the laser light source or at scattered laser light from any reflective surface. Never sight down the beam into the beam source.
5. Maintain experimental setups at low heights to prevent inadvertent beam-eye encounter at eye level.
6. Personnel using the system should wear laser safety eyewear that is optically dense at the specific wavelength being used as a precaution against accidental exposure to the output beam or its reflection.
7. Avoid direct exposure to the light. The intensity of the beam can easily cause flesh burns or ignite clothing.
8. Use the laser in an enclosed room. Laser light will remain collimated over long distances, and therefore, presents a potential hazard if not confined.
9. Post warning signs in the area of the laser beam to alert those present.

10. Advise all those using the laser of these precautions. It is good practice to operate the laser in a room with controlled and restricted access.



DANGER! VISIBLE and INVISIBLE RADIATION

The DP Series Laser may produce both invisible and visible radiation. The invisible radiation is IR. This radiation can easily cause permanent damage to the retina.

2. LASER SAFETY FEATURES


1. **Operating Controls** – Controls for the operation of the DP Series laser system are located on the front of the laser driver box. The controls can be accessed without exposing the operator to laser emission while making adjustments to such controls.
2. **Danger Labels** – Indicates the laser wavelength, maximum pulse energy and minimum pulse width on the back panel of the laser head. The Aperture indicating label, the triangle pointed in the direction of the emitted radiation, with the Laser radiation label below it, are located on the top front of the laser head.



3. UNPACKING AND PARTS IDENTIFICATION

1. All of the system components for the DP Series laser are packaged within 2 container:

 **Caution! Open the laser container carefully. The laser head contains extremely fragile parts.**

 **Caution! Avoid making sharp bends to the laser umbilical cable to prevent damaging the fiber optic cable when unpacking.**

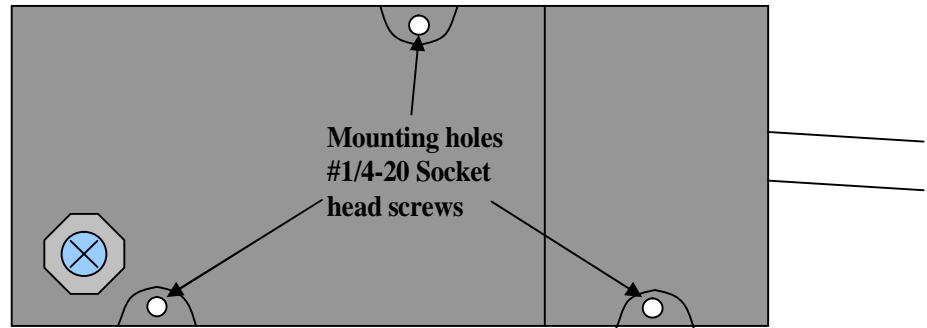
2. The 2 containers contain the DP Series laser head, chiller and the DP Driver/Controller with the main electrical/optical umbilical cable inter-connected between units. Also included, are the incoming AC power cable, RS-232 cable, installation and operation manual, and documentation.

3. Please retain the original packaging materials. If the laser system needs to be shipped back to the factory, use the original packaging materials to avoid damage during shipping.

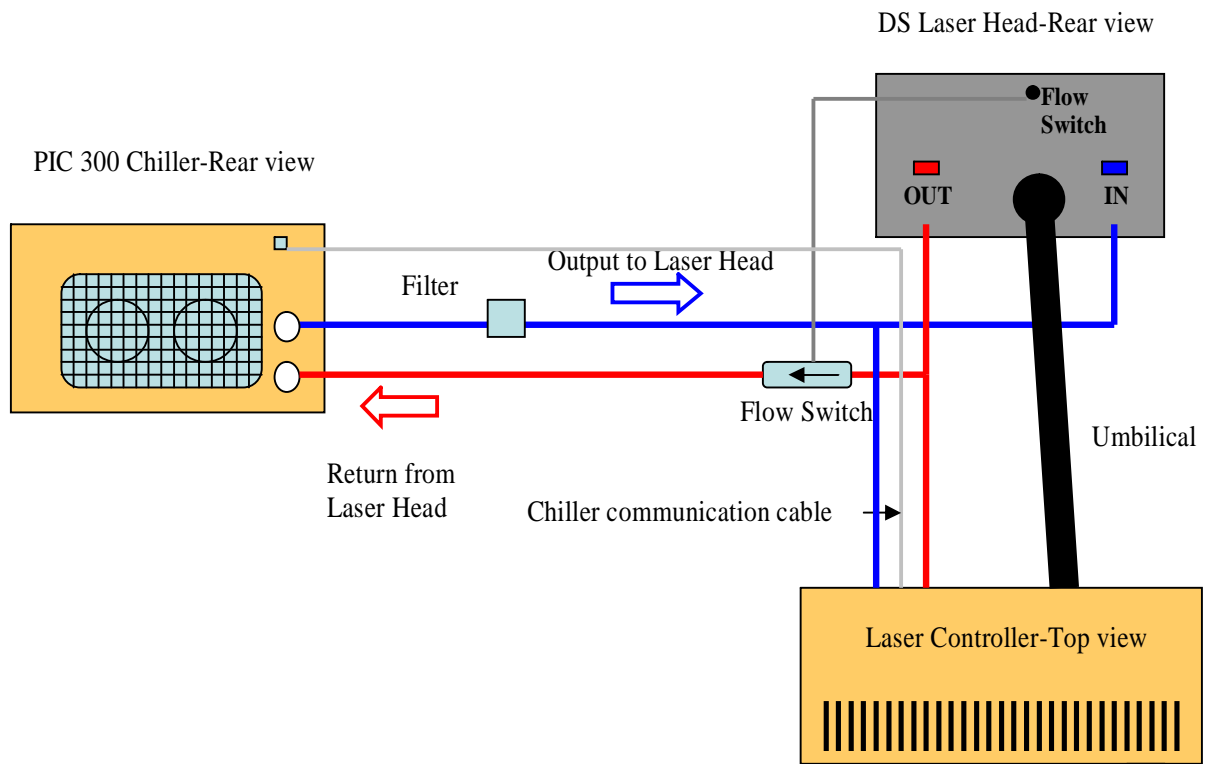
4. Initial Setup

1. The laser head must be bolted to a flat surface using (3) #1/4-20 socket head screws. It is very important that the surface be flat and never use shims under the mounting holes located on the laser head as this can warp the laser head resulting in poor laser performance.
- 2.

Standard DP Laser base



3. Connect all water hoses from the chiller to the laser head, controller and the flow switch at the laser head. The hoses have been color coded and must be connected to the corresponding colors on the laser head, controller and chiller.



4. HARDWARE / ENVIRONMENT AND ELECTRICAL INSTALLATION



Warning! Verify the table/mounting surface for the laser head is properly grounded.

(For the DP series models, the laser diode is located beneath the top cover of the DP laser driver/controller.)

1. Install the DP Series laser head on a grounded optical table, or work surface. (Electrical/Optical umbilical cable is located at the rear side of the laser head.) Make sure the laser head is placed in a safe position. Secure the laser head onto the table using three ¼-20 fasteners at locations shown on the laser base.
2. Install the laser driver in a convenient location for both, ease of operation and unrestricted airflow. Make sure that there is sufficient length for the electrical/optical cable to reach the laser head. **Avoid sharp bends to the electrical/optical umbilical cable to avoid damage to the fiber optic cable. Maintain as large a bend radius as practical during installation; 6 1/2 inches is the minimum bend radius permitted.**

The laser system environment should have an ambient temperature in the range of 15°C to 30°C (59°F to 86°F), relative humidity 90% maximum, non-condensing. Attempted operation above or below this temperature range may result in the laser system generating an error message.

3. Place in position, and secure with fasteners, the 9 pin user DB9 male shutter interlock connector located on the rear panel I/O connector.
4. Plug the AC line cord female connector into the rear panel of the laser diode controller. **Do not connect the male plug to an electrical outlet at this time!**



Important! The outlet for the Laser Controller must be rated for at least 4A/220V or 8A/110V.

5. The driver/controller incoming AC voltage should be confirmed to be within $\pm 10\%$ of above nominal value.
6. Verify that the main power red on/off rocker switch is placed in the down/off position and the laser enable key-switch is in the off position
7. Plug the laser driver box male plug into an outlet that is rated for at least 4A/220V, or 8A/110V. A short audible “BEEP” should be heard.

5. INITIAL START UP OF THE LASER

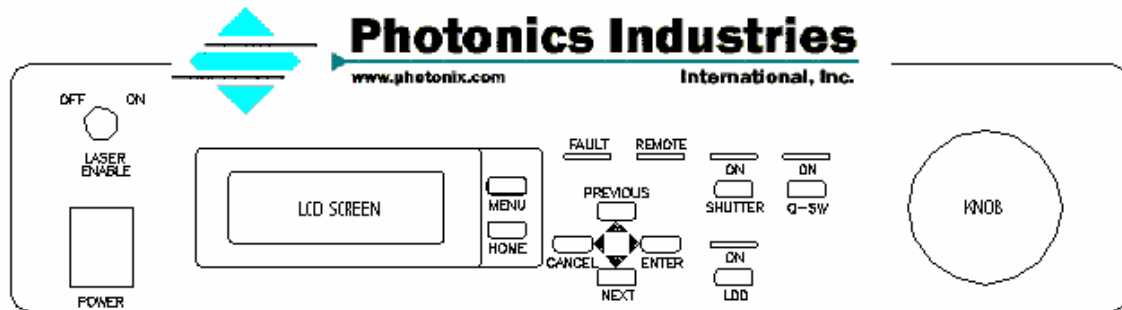


Fig.1 Front Panel of the Laser Driver

1. The laser system should be allowed to reach room temperature before attempting the start up procedure.
2. After the laser driver controller is plugged into the AC source, allow 5 – 10 minutes for the laser temperature to stabilize before switching the main red rocker arm power switch on. After the initial 5 - 10 minute temperature stabilization, turn on the red colored AC power switch on the control/front panel of the driver. At the ON position the power switch will become illuminated. All LED indicators will blink once along with one long, 1 to 2 seconds, audible “BEEP.” The LCD display will also become illuminated, wait at least 10minutes for the chiller to stabilize to the set point temperature.
3. If warnings are displayed, reset the system by pressing the red colored main power rocker switch to the OFF position. Wait a few seconds and turn the system on again by pressing the red colored AC power rocker switch. The fault condition will be reset by the OFF/ON operation.
4. At this stage the Model DP20 laser is ready for operation. Please refer to the next section of this manual for detailed laser operation and control.

Note: Refer to Appendix, page 34, section V, and review functionality description for Gate and the LDD supply before proceeding further.

6. CONTROL PANEL AND LASER OPERATION

I. Description of the control/front panel and the functions of the control buttons

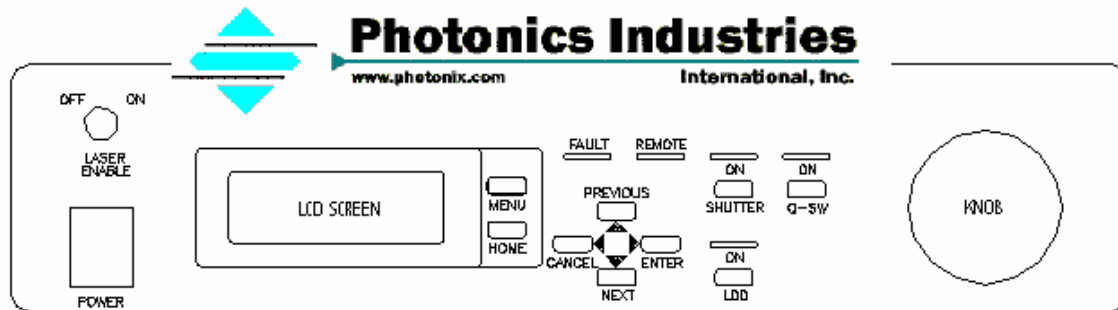


Fig.2 Front Panel of the Laser Driver

1. **Power Switch** – Red colored rocker switch that turns the AC power to the driver ON or OFF.
2. **Laser Enable Key-Switch** – Unlocks or locks the diode driver.
3. **Remote LED** – Illuminated when the unit is being computer controlled, also indicating all the parameters cannot be controlled by the control panel buttons. However, the LDD, Shutter and Q-SW can still be operated from the control panel.
4. **Fault LED** – Blinks when an error occurs. There might be more than one error at the same time.
5. **Shutter button** – Turns the shutter ON or OFF. Shutter ON means that the laser is in operation mode, while shutter OFF means that the laser cannot be operated. There is approximately a 2 to 3 second delay for the shutter to respond after depressing the push-button.
6. **Q-SW button** – Turns ON the Pockel Cell Driver and enables the laser diode power supply to ON.
7. **LDD button** – Turns the laser diode power supply ON or OFF. The laser diode power supply provides current pulses to the pump diode. The laser diode driver cannot be turned ON by pressing the LDD button when the “Laser Enable” key-switch is in the OFF position.

Note: Reference Appendix, p. 34, V, for detailed functionality.

8. **Menu button** – Displays the main menu on the LCD screen. There is a cursor at the first letter of one of the menu selections. We call this cursor the “non-blinking cursor”. The **Previous (▲) / Next (▼)** button can be used to move this cursor.
9. **Home button** – Displays the Home screen that includes the present values of the most useful parameters on the LCD.
10. **Enter button (▶)** – **Enter** has different functions, which are as follows.

Note general comments before proceeding to detailed description below. Two different blinking conditions on the LCD panel will be noted:

- a) A square dark field the size of an alpha-numeric character. Several square dark field alpha-numeric characters will be displayed in a horizontal line. These form a blinking dark field line. The parameter value or parameter status cannot be changed when this square dark field is displayed. This is the specific menu or sub-menu parameter selected that may be changed.
- b) Depressing **Enter** on a blinking square dark field will result in the LCD panel display blinking the presently valid alpha-numeric character values. At this blinking condition the selected parameter value can be changed by use of the knob rotation or buttons described in detail below.

When the menu is shown on the LCD screen, **Enter** takes the user from this menu screen to the selected sub-menu screen. The selected sub-menu on the main menu screen is marked by the non-blinking cursor. The non-blinking cursor can be moved by the **Previous (▲) / Next (▼)** button to select a different sub-menu.

The **Enter** button is pushed on a desired parameter location of a sub-menu, the blinking cursor on that location will prompt the user to change the required value of that parameter with the aid of the **Previous (▲) / Next (▼)** buttons.

If the **Enter** button is pushed when a parameter is in the blinking cursor status, the parameter will return to non-blinking cursor status and the displayed value for that parameter will become the set value. For all parameters, except the current setting, change operation is completed by pushing Enter. The value changed will be applied and become the set value. The current setting is an exception and will change as it is increased or decreased without requiring the **Enter** button to be pushed after the setting. However, it is recommended to push the **Enter** button after reaching the required current value.

11. **Cancel button (◀)** – Takes the user from blinking cursor status to non-blinking cursor status. Any change of the parameter where the blinking cursor is will be aborted.
12. **Previous (▲) / Next (▼)** button – Moves the non-blinking cursor to select the Previous or Next changeable parameter. After moving the non-blinking cursor to the desired parameter location, the user should press **Enter** to have the blinking cursor so that it is possible to change that particular parameter.

When the cursor is blinking at a desired parameter location, the **Previous (▲) / Next (▼)** button is required to be used again to increase or decrease the value of that particular parameter respectively.

A single push of the **Previous** button will increase, while a single push of the **Next** button will decrease the value of the parameter under the blinking cursor stepwise.

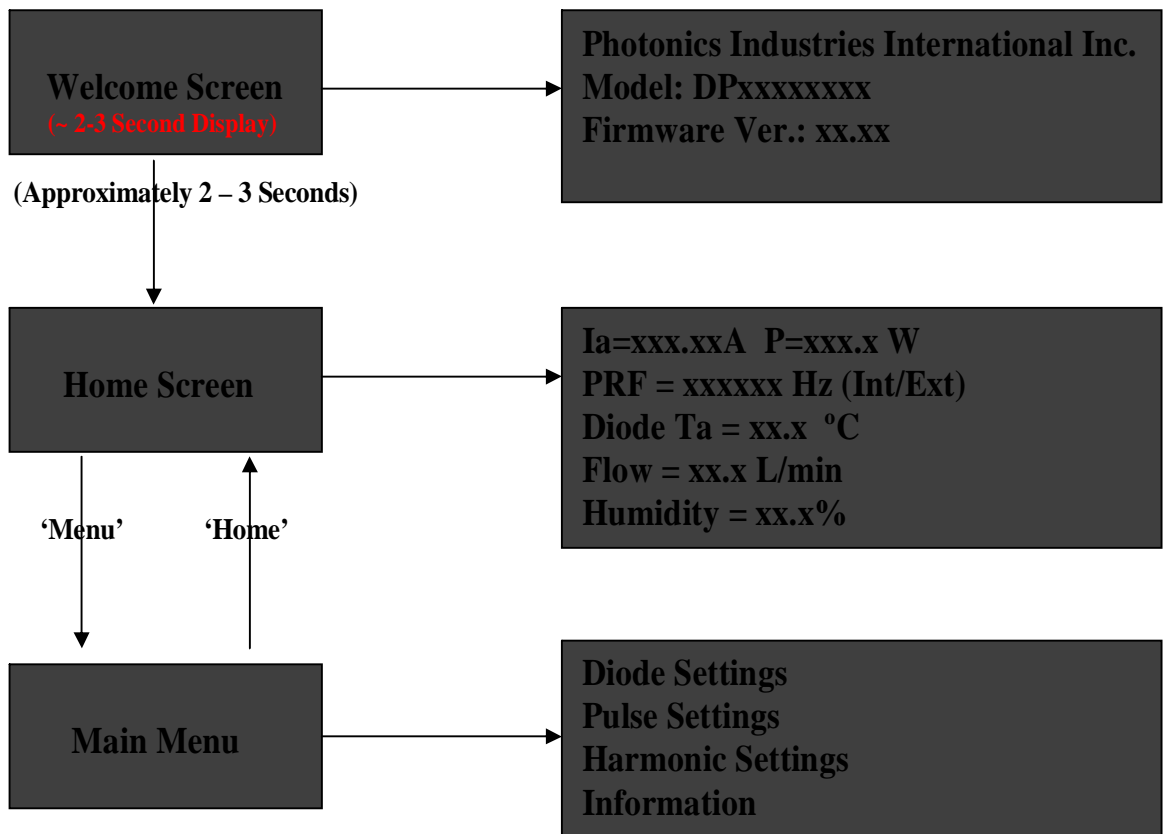
Holding of any of the two mentioned buttons, will change the value of the parameter under the blinking cursor, slowly at the beginning and with increased speed with time.



Important! Always use a single push of the button or use the rotary knob to change the current value. Speeding up the current change by holding the **Previous (▲) / Next (▼)** button may result in current overshoot since the current value is a “real time” parameter.

13. **Knob** – Besides the **Previous (▲)** / **Next (▼)** buttons, the rotary knob can also be used to change the parameter values under the blinking cursor at a speed proportional to the knob rotation. Clockwise turning of the knob will increase, while counter-clockwise turning will decrease the parameter values.

II LCD Menu Structure and Definition of Control Parameters



II LCD Menu Structure and Definition of Control Parameters

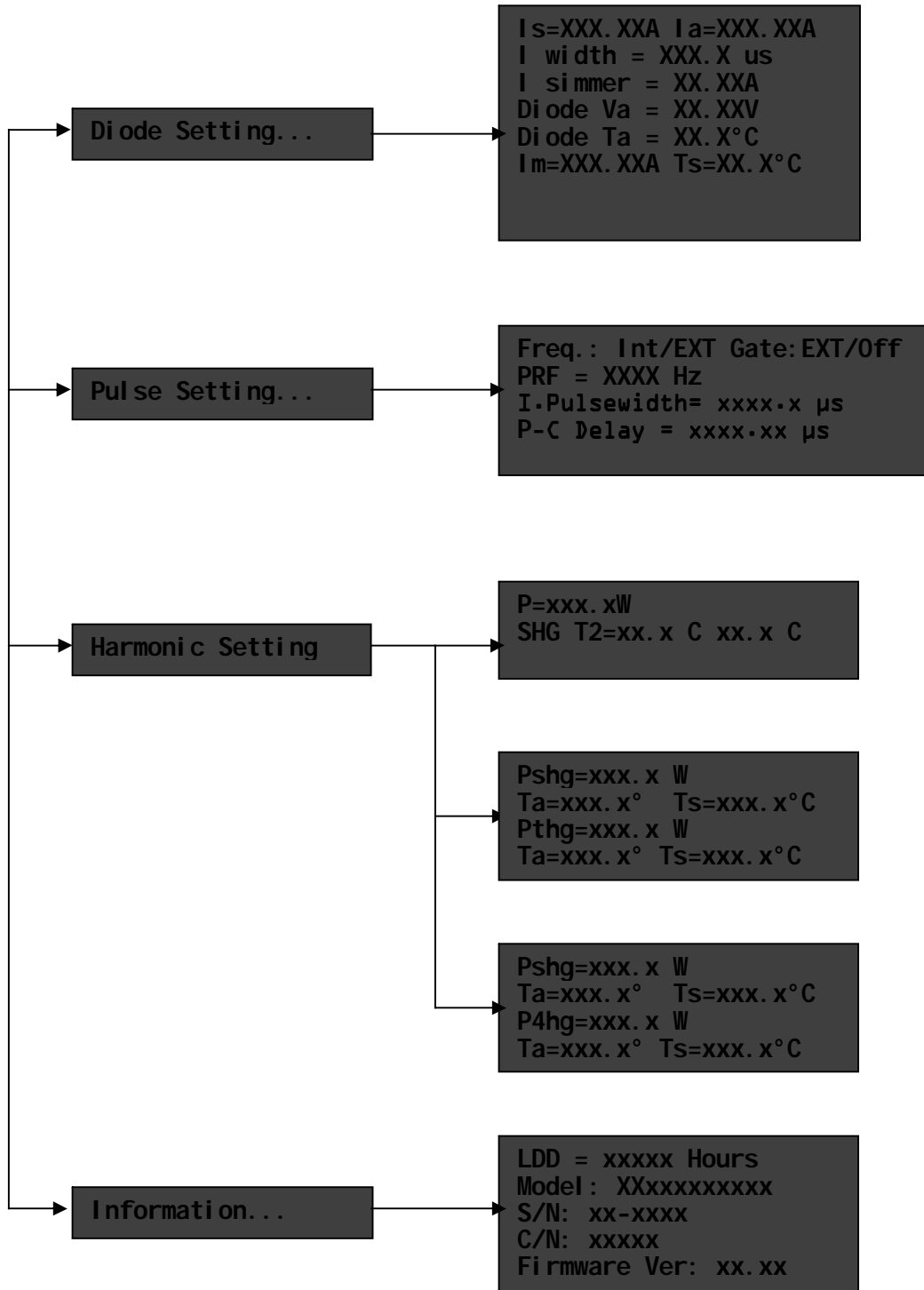


Fig.3 LCD Menu Structure

Diode setting parameters:

- Diode setting current (Is): Current that the user can adjust and set a desired value to drive the laser diode.
- Actual peak diode current (Ia): Read only parameter that shows actual peak current to the laser diode.
- Diode Temp: Actual temperature (Ta) of the laser diode.
- Diode Volt: Actual operating voltage of the laser diode.
- Upper limit of diode setting current (Imax): Maximum current level to the diode that can be reached by changing (Is); Imax is set by the manufacturer.
- Ts: The laser diode operating temperature is determined and set by the manufacturer. If the displayed diode temperature (Diode Temp) is higher, or lower than (Ts), an alarm may be activated to warn the user, and at the same time the laser will be shutdown automatically. The actual temperature limits set for the laser diode are +5°C for the lower limit and +33°C for the upper limit.

Pulse setting parameters:

- Q – SW key: Can be set to Disable or Enable mode.
- Freq: Can be set to either internal (INT) or external (EXT) mode to generate Q-switched laser light pulses.
- PRF: Can be changed when the Freq parameter is in INT mode. The Rep Rate is the Q-switched pulse rate of the laser. This is a read only parameter when the Freq is in EXT mode.
- Off-time: Default parameter value set by the manufacturer. The user should not change the Off-time value. The “Off-time” value in nano-seconds will be equal to the SYNC OUT pulse width.

Harmonic setting parameters:

- SHG (Ta)=xx.x°C (Ts)=xx.x°C; THG (Ta)=xx.x°C (Ts)=xx.x°C: The first number (Ta) is the actual temperature for the crystals; the second number (Ts) is the set temperature for the crystals. They may not be identical.

NOTE: For harmonic lasers, the SHG & THG upper limit Temperature Set (Ts) must not be set greater than 55°C. The lower limit Temperature Set (Ts) must not be set lower than 46.5 °C. Operation outside of above temperature range will result in a visual alarm with erratic temperatures displayed on the LCD panel.

Information:

- **Total diode operating hours are given in this sub-screen.**
- **Model : XXxxxxxxxx**
- **S/N: xx-xxxx**
- **C/N: XXXXX (five digit controller chassis serial number)**
- **Firmware Ver: xx.xx**

III. Procedure for laser set-up and operation

After switching the control panel red colored AC rocker switch to ON, check the following items for safety reasons and to prevent damage to the laser equipment before operating the laser:

- i) The user should wear laser safety goggles during the whole laser operation.
- ii) Depending on the application, the **FREQ** parameter should be set to **INT** or **EXT**.
- iii) The repetition rate should be set according to the test report.
- iv) The diode current setting (**Is**) should be set lower than 1 Ampere.

After the above steps have been followed, the user should proceed in the following sequence, step by step, to operate the laser:

- i) **QSW** push-button should be in the **ON** condition; green colored LED illuminated.
- ii) Press the **Menu** button to display the main menu. Press the **Previous/Next** button to select the Diode Setting menu, and then press **Enter** to display the diode setting sub-menu.
- iii) Turn the laser enable key-switch **ON**.
- iv) Press the **LDD** button and observe that the green LED, above the pressed button, is illuminated.
- v) Press the **Shutter** button **ON** and observe that the green LED above the pressed button is illuminated.

As soon as the **LDD** button is pressed, and the shutter opened, current will be automatically applied to the laser diode. The change of actual current (**Ia**) will be displayed on the Laser Diode sub-menu until it reaches the set current value **Is** (which should be lower than 1 Ampere). To change the current, press the **Previous/Next** button to move the cursor to the **Is** parameter location. Then press the **Enter** button to make the cursor blink.

At this stage, the user can either use the **Previous/Next** button, or the knob to change the current setting **Is**. Change of **Is** will change the actual current value **Ia** accordingly. **NEVER** change the current value by holding the **Previous/Next** button, this action could damage the laser by current overshoot.

For damage prevention, the Laser Controller is designed in such a way that the actual current always changes gradually with a ramp of 3 Amperes per second.

- vi) If the internal frequency change is required, press the **Menu** button and then go to the main menu screen. Next, press the **Previous/Next** button to move the cursor to the pulse setting, and press **Enter** to display the pulse setting sub-menu screen.

Use the **Previous/Next** button to move the cursor to the Rep Rate parameter and press **Enter** to make the cursor blink. At this stage, either by using the **Previous/Next** button or knob, the Rep Rate parameter can be changed. Depress **Enter** to save this value for the laser output pulse rate.

IV. Procedure for laser shutdown

1. Decrease the current setting value **Is** below 1 ampere. Depress the **Enter** push-button to save this change to the system.
2. Depress the **LDD** push-button to turn off the laser diode driver.
3. De-press the **Shutter** button to OFF.
4. Depress the **QSW** push-button to turn off the Pockel Cell Driver and LDD power supply.
5. Turn the **Laser Enable** key counter-clockwise to OFF to lock the laser diode driver.
6. Switch the red colored **AC Power** rocker switch to OFF.
7. The system is now operating in “standby” mode.

Note: Reference Appendix, p. 34, V, for detailed functionality.

7. EXTERNAL CONNECTIONS

Description	Function
AC Power	To supply power to the Laser Driver 110/220VAC
Connector to Laser Head	A multi pin connector to connect the Laser driver with the Laser head.
User I/O	<p>a) A simple jumper connector is provided as a safety shutter interlock. When removed, the shutter in the laser closes to prevent lasing.</p> <p>b) Laser Emission circuitry. When all lasing conditions met, eg. laser intra-cavity shutter open, laser diode current present, etc., pin 13 will be a TTL High.</p> <p>c) Hardware Fault Signal. A system error will result in pin 12 to be TTL High for the "System Fault" output.</p>
Ext F.P.S.	Not Applicable for Model DP Lasers
Sync Out	Trigger signal output for synchronization and monitoring.
Ext Freq	External TTL trigger signal level input.
Ext Gate	External TTL gate signal level input.
P.C.	RS-232 to user supplied PC for computer control of the laser system.

Table 1. External Connections

External Electrical Signal Description

The following description describes the amplitude and pulse width requirements for the external frequency signal to be provided to the Laser Controller. The Laser Controller software is factory set to respond to the rising edge, of the external input signal for the EXT FREQ F-BNC connector.

Ext GATE

A female BNC connector located on the rear panel of the laser driver/controller provides for a TTL level signal, +5 volts or TTL "high," at the input provides laser output. A TTL "low" provides not laser output.

The GATE selection, Internal or External, is made via a toggle switch located on the rear panel of the Laser Controller and NOT by selection in the "PULSE" settings menu in the LCD Control Board.

Synchronize Output (Sync Out)

A female BNC connector located on the rear panel of the laser driver/controller provides a TTL level signal for the monitoring or synchronizing of the laser light. When connected to a high impedance (1 megohm, 20.pf) input of an oscilloscope, the output synchronizing pulse, when Q-switched, will be approximately +5 volts in amplitude.

When the laser is Q-switched, the level will go from ground to ~ +5 volts for the duration of the preset off-time, typically set to 2 micro-seconds. The positive going synchronizing pulse occurs at the Q-switched repetition rate of the laser. The rise time from ground to +5 volts will be dependent upon the length and electrical characteristics of the cable connected between the F-BNC Sync connector and the load.

To best preserve observed waveform use 50 ohm coaxial cable (RG58/U) connected to the Sync out F-BNC connector and terminate the cable end at the oscilloscope into 50 ohms. This will result in an approximate +1.5 volt pulse having a rise-time <20 nano-seconds at the Q- switched repetition rate. The synchronizing signal pulse-width is typically 2 micro-seconds in duration as determined by the preset off-time.

External Frequency (Ext Freq)

The system is shipped with the default setting in the controller menu set to Freq: Int. To use the Freq: Ext function, go to the Pulse Setting Menu and select Freq. And enter Ext. At this time the External Frequency F-BNC connector is active.

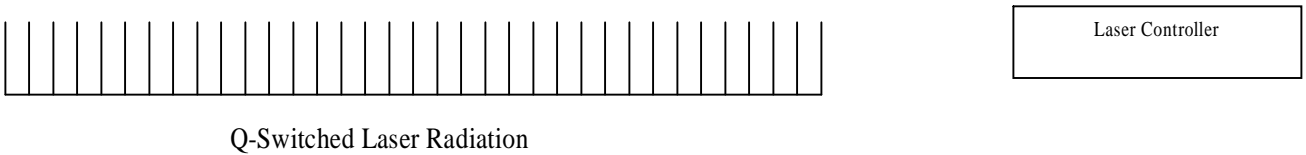
An external TTL signal, positive going, with a minimum pulse width of 100. nano-seconds, ~10. nano-seconds rise-time and > 3.5 volts amplitude will satisfy the external frequency trigger requirements.

For long physical distances, and minimum response time, use of 50 ohm coaxial cable terminated with a thru-line 50 ohm termination placed at the Ext Freq F-BNC connector at the rear panel of the laser driver is recommended.

8. TYPICAL INTERCONNECTIONS TO LASER CONTROLLER

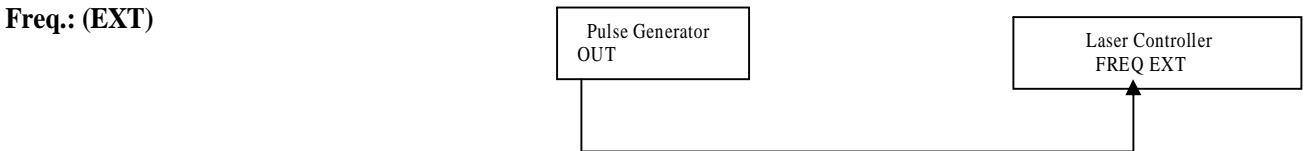
Example I:

Freq: (INT) (Internal Q-Switched Operation)



Example II:

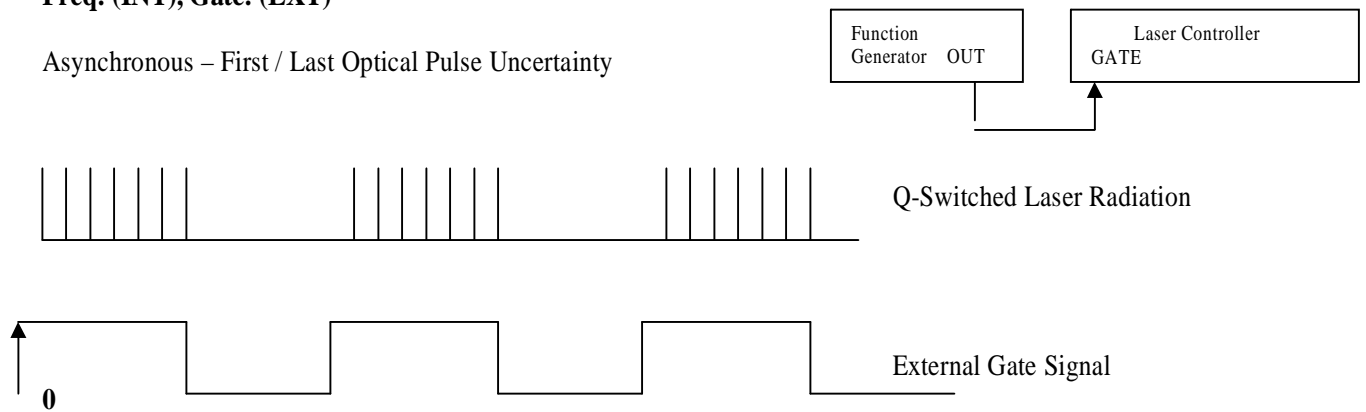
Freq.: (EXT)



Example III:

Freq: (INT), Gate: (EXT)

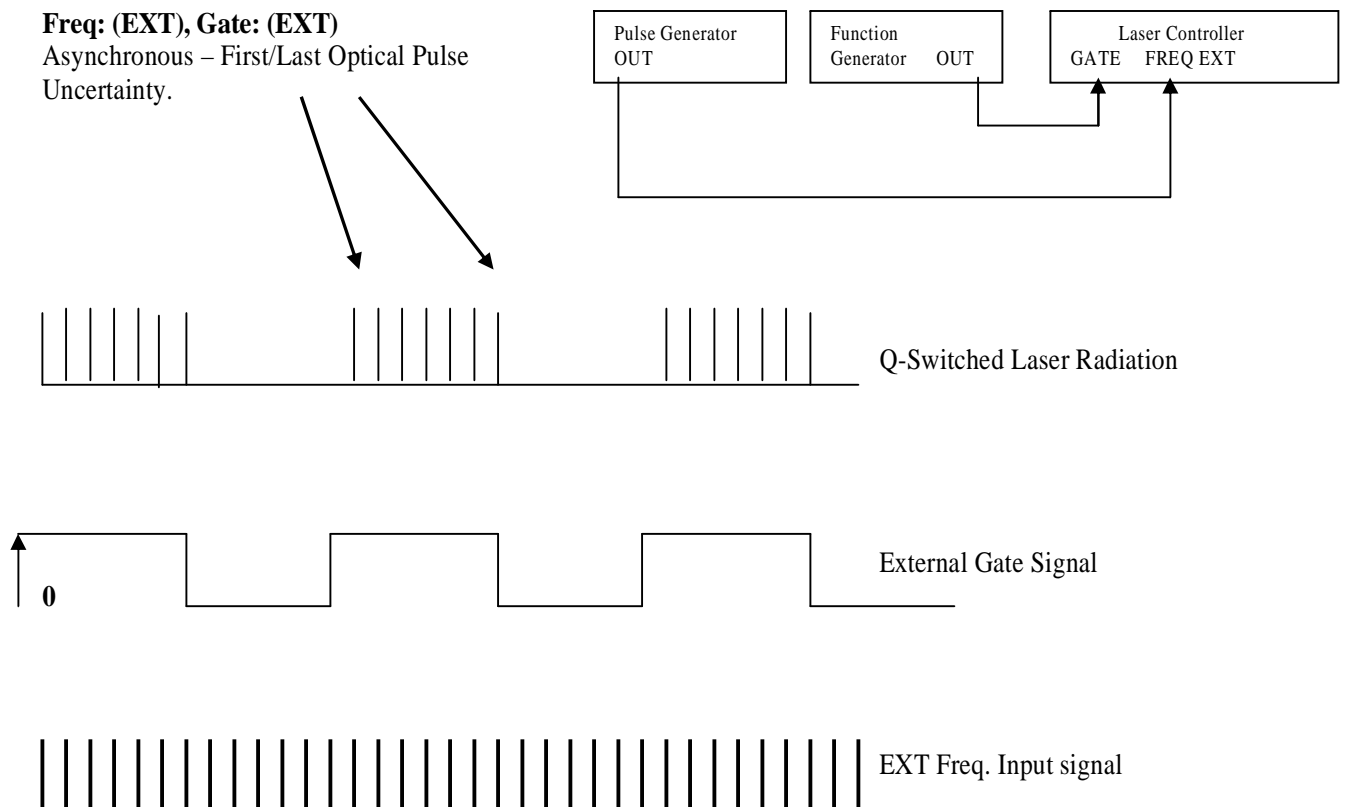
Asynchronous – First / Last Optical Pulse Uncertainty



Example IV:

Freq: (EXT), Gate: (EXT)

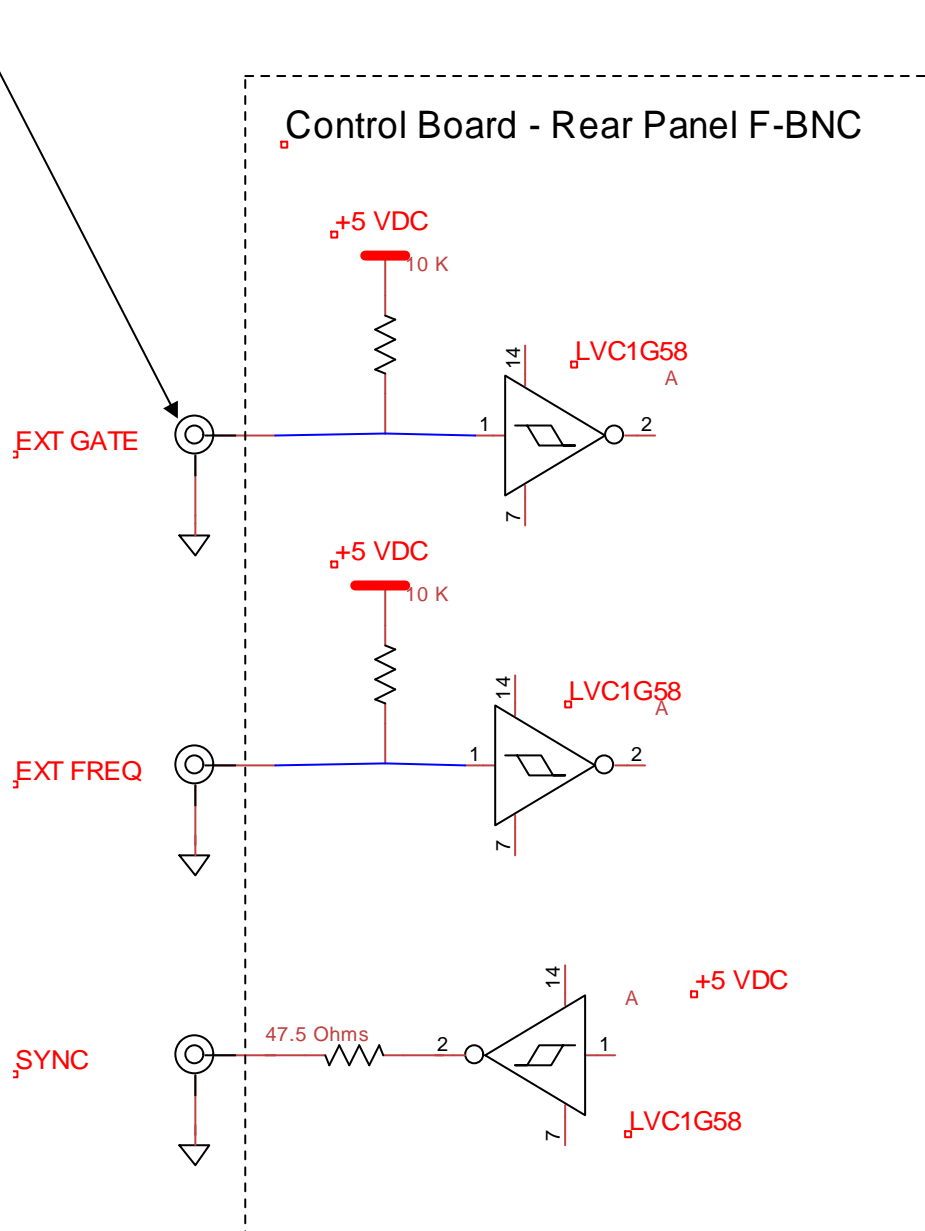
Asynchronous – First/Last Optical Pulse Uncertainty.



In example IV above, the EXT FREQ Pulse Generator and Function Generator are not synchronized. It is possible that the EXT GATE signal could fall between two pulses and would generate one less light pulse.

Simplified Electrical Interface for EXT FREQ and SYNC OUT

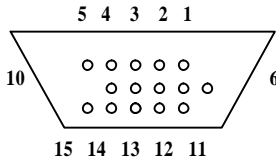
F-BNC connectors located on rear panel of Laser Controller



9. INTRACAVITY SHUTTER INTERLOCK / ELECTRICAL INDICATORS

Rear Panel I/O

15 Pin Connector - Female



End View

Intra-Cavity Laser Shutter Interlock

Pin 5 and Pin 10 of the Interface are always jumpered (shorted) to bring +5 Volts to the intra-cavity shutter circuitry. This inter-connection may be used as a high level hardware intra-cavity beam shutter interlock.

Pin 3 and Pin 7 of the Interface are used for the digitally controlled intra-cavity beam shutter Interlock. When Pin 3 and Pin 7 are disconnected, the shutter will be OFF/CLOSED/NO LASING. Use of dry N .C. relay contacts or an Opto-Isolator suggested.

By factory default setting, for laser safety considerations, reconnection of Pin 3 to Pin 7 will not result in immediate re-opening of the shutter. The laser controller front panel shutter button will have to be depressed to reopen the intra-cavity shutter.

Note: The factory default software setting can be changed, by a Photonics Industries Representative, to immediately reopen the intra-cavity shutter upon re-connection of Pin 3 to Pin 7.

Laser System Operating, System Fault and Shutter Overload Output Signal

Pin 8 and Pin 12 of the I/O connector is used for “System Fault” signal output.

Pin 8 and Pin 13 of the I/O connector is used for “Laser System Operating” status TTL High output level when the LDD, Shutter and QSW are turned ON.

Pin 8 and Pin 11 of the I/O connector is used for the “Shutter Overload” signal.

Note:

For all above output signals, a +5V D.C. level is present having a maximum current drive capability of ~20 milliamperes. This voltage/current level can be electrically interfaced by end-user circuitry.

Rear Panel User I/O Interface (DB15 D-Subminiature Female pinout)

Pin No.	Description
1	Do Not Make an Electrical Connection
2	Do Not Make an Electrical Connection
3	Shutter Interlock - Logic (+5)
4	Empty
5	Shutter Power (+)
6	Do Not Make an Electrical Connection
7	Shutter Interlock - Logic Return
8	Status Level Returns – Circuit Common <i>Laser System Operating / System Fault / Shutter Over-load</i>
9	Circuit Common (Ground)
10	Shutter Power (-)
11	Shutter Overload Status (+)
12	System Fault Status (+)
13	Laser System Operating Status (+)
14	Do Not Make an Electrical Connection
15	Empty

Fig.6 Shutter Interlock and Hardware Indicators

Pin 3 to pin 7 Logic Shutter Interlock

Pin 5 to pin 10 Hardware Shutter Interlock

Mating 15 pin D-Subminiature Male Connector:

Body - Mfg. P/N 40-94115HDM / Photonics Industries P/N 2028051 / Allied P/N 510-2300

Note: D-Sub Crimp Kit (Hood and male pins) required for above I/O Connector

DP Laser Controller / Shutter Interlocks / LED Drivers

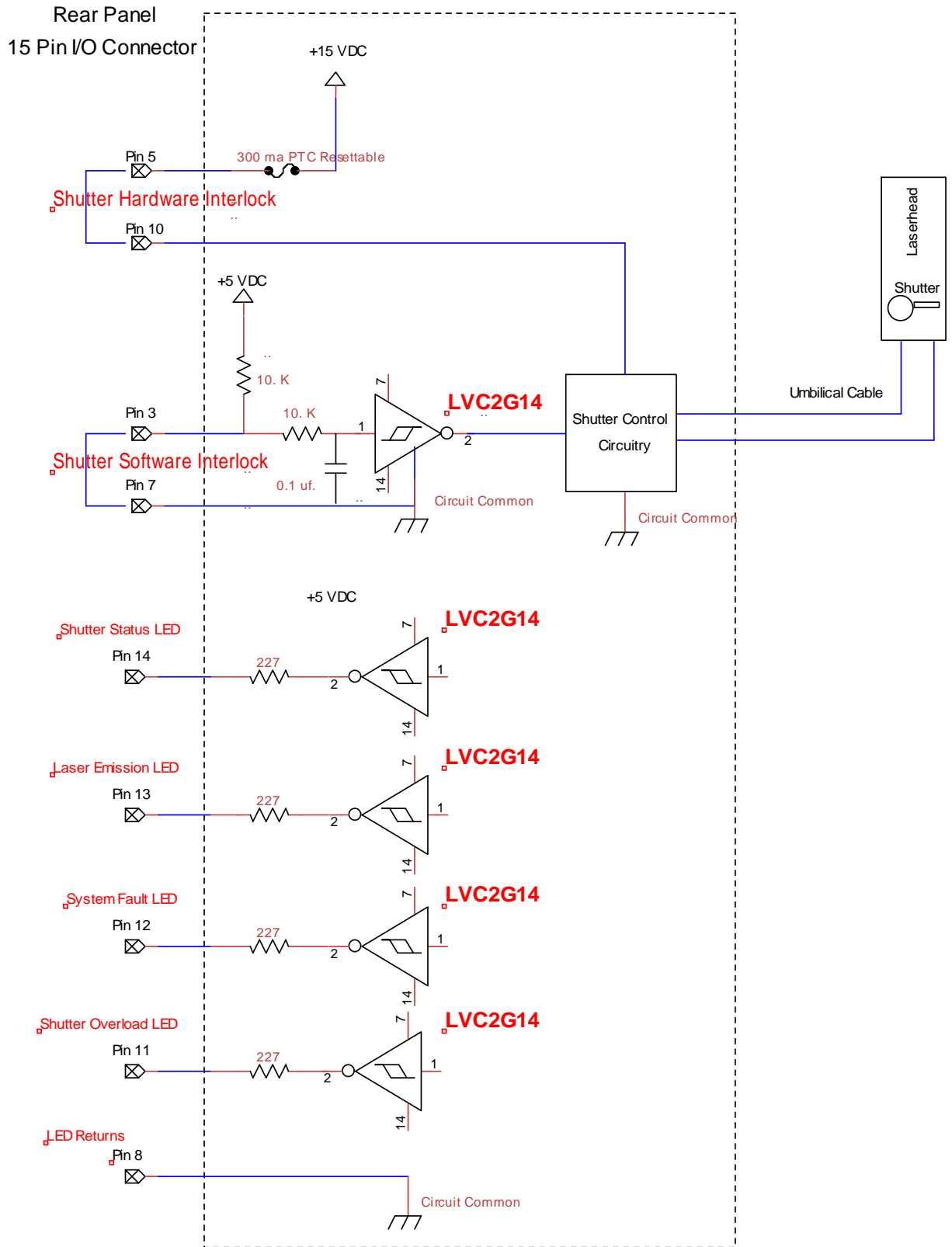
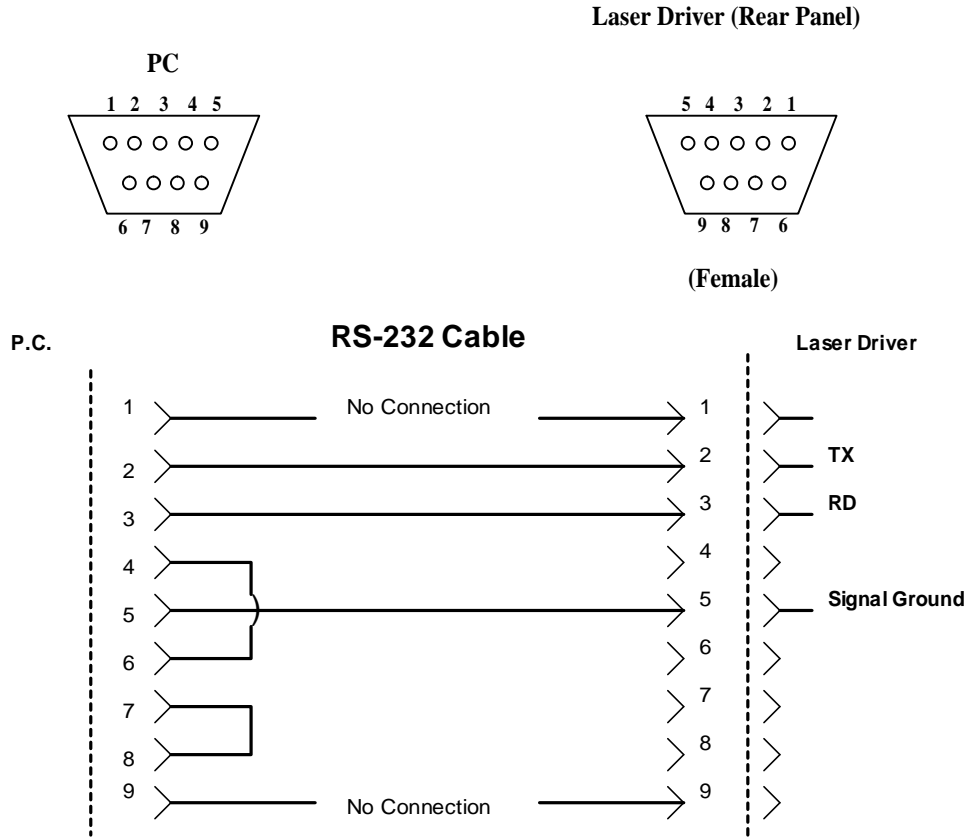


Fig.6 Shutter Interlock and Hardware Indicators

10. CABLE PIN DIAGRAM – RS-232



Pin Num PC	Description	Pin Number Laser Controller	Description
1	No connection	1	No connection
2	Transmitted Data	2	Transmitted Data
3	Received Data	3	Received Data
4	Shorted with pin 6 (On PC side)	4	No connection
5	Signal Ground	5	Signal Ground
6	Shorted with pin 4 (On PC side)	6	No connection
7	Shorted with pin 8 (On PC side)	7	No connection
8	Shorted with pin 7 (On PC side)	8	No connection
9	No connection	9	No connection

Table 3. RS-232 Cable from PC to LDD

11. Laser Controller Definitions for use with RS-232 Communication

LDD	= Laser Diode Power Supply
Q-SW	= Pockel Cell
PC	= Personal Computer
Is	= Laser Diode current set in Amperes
Ia	= Actual Average Laser Diode current read in Amperes
Ts	= Temperature Set in °C
Ta	= Actual Temperature read in °C
QSW Key Enable	= Front Panel QSW push-button switch enabled permits changing set state; Pockel Cell ON or OFF.

Edited (11/23/2010) DP New Platform Laser Controller RS-232/485 Communication
11/02/2010

Format: **RS-232 is transmitted in HEXASC.**
19.2K baud,8D,NP,1S, terminated with CR.
RS485 is half-duplex.

The PC always will send one message, and then get one response message from the LP (laser power controller).

Transmit Frame - Format [C#1][C#2][D#1][D#2][D#3][D#4]... [CS][CS] h

Byte #0 C#1 - Command Byte #1 (no. of data word, max=15, not including CMD, CS)
- Upper nibble: in RS232 should be 0; in RS485 should be device id.

Byte #1 C#2 - Command Byte #2 (PC to LP MSB = 0, LP to PC MSB = 1)

Byte #2 D#1 - Data Word 1 Byte #1 (MSB)

Byte #3 D#2 - Data Word 1 Byte #2 (LSB)

Byte #4 D#3 - Data Word 2 Byte #1 (MSB)

Byte #5 D#4 - Data Word 2 Byte #2 (LSB)

.

.

Byte CS - 16 Bit Checksum Byte #1 (MSB)

Byte CS - 16 Bit Checksum Byte #2 (LSB)

Checksum: sum of each byte

CHAR - One byte data - [B#1][00] to form [D#1]

SHORT INT - Two byte data - [B#1][B#2] to form [D#1]

LONG INT - four byte data - [B#1][B#2][B#3][B#4] to form [D#1][D#2]

The LP may have limited buffer for ([CMD]+[15WORDS]+[CS]) memory space to receive RS-232 data from PC.

// -----

Example 1: Set parameter**09h SET CURRENT (0.01A UNIT)****Definition - set current****Format [01][09][XX][XX][CS][CS] h****Set current to 1.00A [01][09][00][64][00][6E] h****Response [01][FF][09][00][01][09]h****ACKNOWLEDGE RECEPTION****Definition - to acknowledge any command that does not request a value****Format - [C1][C2][A1][A2][CS][CS]h****C1: upper nibble - device id****Lower nibble - no. of data word****In RS232 always will be 0x01.****C2: acknowledge command always be 0xFF****A1#: command (echo)****A2# = 00 when transmission is valid****A2# = 01 checksum error (also used as a re-transmit request)****A2# = 02 number of word over max. (15)****A2# = 03 length wrong****A2# = 04 Invalid Command Code****A2# = 05 Invalid Data Value [Out of Range]****A2# = 06****If the total bytes of the command are less than 8, there is no response from the LPS.****Example 2: Inquire parameter from LP****0Bh INQUIRE ACTUAL CURRENT MEASUREMENT****Definition - request actual current measurement from the LP Controller.****Format [00][0B][CS][CS]h****Inquire actual current [00][0B][00][0B]h**

8Bh RESPONSE ACTUAL CURRENT MEASUREMENT

Definition - response actual current measurement to the PC.

Format [01][8B][D#1][D#2][CS][CS]h

[01]: no. of data word

[8B]: command with MSB set

[D#1][D#2]: data

If actual current = 1.00A

Response [01][8B][00][64][00][F0]h

LED status

1. If the LPS receives command successfully, the remote green led will flash, otherwise the fault red led will be on for 3 seconds if there is no communication afterwards.

// COMMAND LIST:

Request LD time in 0.1 hour units

LDD1: 027F061002000099

Response:

02FF[XX][XX][XX][XX][CS][CS]h Unit 0.1 hours

00h TURN ON (1)/OFF (0) THE LDD

Format [01][00][T#][00][CS][CS]h

[T#]: 1: ON, 0: OFF

01h TURN ON (1)/OFF (0) SHUTTER

Format [01][01][T#][00][CS][CS]h

[T#]: bit0 - 1: ON, 0: OFF

02h TURN ON (1)/OFF (0) Pockel Cell

Format [01][02][T#][00][CS][CS]h

[T#]: bit0 - 1: ON, 0: OFF

03h TURN ON (1)/OFF (0) KEYPAD EDITTING

Format [01][03][T#][00][CS][CS]h

[T#]: bit0 - 1: ON(REMOTE LED ON), 0: OFF(REMOTE LED OFF)

05h TURN ON (1)/OFF (0) CHILLER

Format [01][05][T#][00][CS][CS]h

[T#]: bit0 - 1: ON, 0: OFF

07h RESET LASER CONTROLLER TO RESTART AGAIN

Format [01][07][T#][00][CS][CS]h

[T#]: bit0 - 0: OFF(RESET LPS)

08h INQUIRE STATUS BYTE OF ABOVE

Format [00][08][CS][CS]h

Response [01][88][S#][00][CS][CS]h

[S#]:

bit0 - LDD ON/OFF

bit1 - SHUTTER ON/OFF

bit2 - POCKEL CELL ON/OFF

bit3 - KEYPAD EDIT ENABLE/DISABLE

bit4 -

bit5 - CHILLER ON/OFF

bit6 - 0: "Laser Enable" KEY OFF; 1: "Laser Enable" Key ON

bit7 - POWER KEY SW ON

09h SET CURRENT (0.01A UNIT)

Format [01][09][I#1][I#2][CS][CS]h

0Ah REQUEST CURRENT SETTING (0.01A UNIT)

Format [00][0A][CS][CS]h

Response [01][8A][I#1][I#2][CS][CS]h

0Bh REQUEST ACTUAL CURRENT MEASUREMENT (0.01A UNIT)

Format [00][0B][CS][CS]h

Response [01][8B][I#1][I#2][CS][CS]h

0Ch SET CURRENT HIGH LIMIT (0.01A UNIT, MAXIMUM 200A)

Format [01][0C][I#1][I#2][CS][CS]h

0Dh REQUEST CURRENT HIGH LIMIT (0.01A UNIT)

Format [00][0D][CS][CS]h

Response [01][8D][I#1][I#2][CS][CS]h

0Eh REQUEST DIODE VOLT MEASUREMENT (0.01V UNIT)

Format [00][0E][CS][CS]h

18h SET INTERNAL FREQUENCY(MAX-300000,MIN-1)

Format [02][18][F#1][F#2][F#3][F#4][CS][CS]h

19h INQUIRE FREQUENCY

Format [00][19][CS][CS]h

Response [02][99][F#1][F#2][F#3][F#4][CS][CS]h

INT: SET INTERNAL FREQUENCY

EXT: MEASURED FREQUENCY

24h TURN ON (1)/OFF (0) POCKEL CELL KEY DISABLE

Format [01][24][T#][00][CS][CS]h

[T#]: bit0 - 1: ON, 0: OFF

26h TURN ON (1)/OFF (0) EXTERNAL FREQUENCY

Format [01][26][T#][00][CS][CS]h

[T#]: bit0 - 1: ON, 0: OFF

27h TURN ON (1)/OFF (0) EXTERNAL GATE

Format [01][27][T#][00][CS][CS]h

[T#]: bit0 - 1: ON, 0: OFF

28h INQUIRE STATUS BYTE OF ABOVE

Format [00][28][CS][CS]h

Response [01][A8][S#][00][CS][CS]h

[S#]:

bit0:

bit1:

bit2:

bit3:

bit4: POCKEL CELL KEY DISABLE ON/OFF

bit5:

bit6: EXTERNAL FREQUENCY ON/OFF

bit7: EXTERNAL GATE ON/OFF

3Ah SET SIMMER CURRENT (0.01A UNIT)

Format [01][3A][I#1][I#2][CS][CS]h

3B REQUEST SIMMER CURRENT SETTING (0.01A UNIT)

Format [00][3B][CS][CS]h

Response [01][BB][I#1][I#2][CS][CS]h

3Ch SET DP I.PULSEWIDTH(unit: 0.1us) and DELAY TIME (UNIT: 0.01us)

Format [03][3C][WIDTH][D#1][D#2][[CS][CS]h

[WIDTH]: FROM 10 TO 1000 (.1us)

[DELAY]: FROM 5 to 200000(0.01us)

3Dh INQUIRE I.PULSEWIDTH(unit:0.1us) and DELAY TIME (UNIT: 0.01us)

Response [03][BD][WIDTH][D#1] [D#2][CS][CS]h

The Fault LED and Remote LED will indicate communication status also.

79h INQUIRE ERROR STATUS (bit set to 1: error, 0: OK)

Format [00][79][CS][CS]h

Response [02][F9][E#1][E#2][S#1][S#2][CS][CS]h

[E#1][E#2]: sensor fault & error (may be enabled/disabled)

bit15: low flow error

bit14: wet sensor error

bit13:

bit12: Pockel Cell switch alarm

bit11.

bit10

bit09:

bit08: LDD #1 fault

bit07: Pockel Cell temp error.

bit06: Laser crystal temp error .

bit05:

bit04:

bit03: THG temp. error

bit02: SHG temp. error

bit01: humidity sensor error

bit00 : diode temp. error

[S#1][S#2]: system error(can not be disabled)

bit15:

bit14:

bit13:

bit12:

bit11:
bit10:
bit09:
bit08:
bit07:
bit06:
bit05:
bit04:
bit03:
bit02:
bit01:
bit00:

// TEMPERATURE COMMAND

7Bh SET TEMPERATURE (UNIT 0.1 C)

Format [08][7B][T1#1][T1#2][T2#1][T2#2]
...[T6#1][T6#2][T7#1][T7#2][CS][CS]h

[T1#1][T1#2]: Diode temperature
[T2#1][T2#2]: Chiller temperature
[T3#1][T3#2]: SHG temperature
[T4#1][T4#2]: THG temperature
[T5#1][T5#2]:
[T6#1][T6#2]:
[T7#1][T7#2]:
[T8#1][T8#2]:

7Ch INQUIRE SETTING TEMPERATURE (UNIT 0.1 C)

Format [00][7C][CS][CS]h
Response [08][FC][T1#1][T1#2][T2#1][T2#2]
...[T6#1][T6#2] [T7#1][T7#2] [CS][CS]h

[T1#1][T1#2]: Diode temperature
[T2#1][T2#2]: Chiller temperature
[T3#1][T3#2]: SHG temperature
[T4#1][T4#2]: THG temperature
[T5#1][T5#2]:
[T6#1][T6#2]:
[T7#1][T7#2]:
[T8#1][T8#2]:

7Dh INQUIRE ACTUAL TEMPERATURE (UNIT 0.1 C)

Format [00][7D][CS][CS]h

Response [08][FD][T1#1][T1#2][T2#1][T2#2]

...[T8#1][T8#2][CS][CS]h

[T1#1][T1#2]: Diode temperature

[T2#1][T2#2]: Chiller temperature

[T3#1][T3#2]: SHG temperature

[T4#1][T4#2]: THG temperature

[T5#1][T5#2]:

[T6#1][T6#2]:

[T7#1][T7#2]:

[T8#1][T8#2]:

14. APPENDIX

In Case of Difficulty

The following describes general visual and audible conditions that will aid in diagnosis. No tools or test equipment required. The bold type is the observed symptom; text below the bold type is expected response or action item.

System Fails to Initialize / Red colored ON/OFF indicator of AC rocker switch does not illuminate in the ON position:

Verify that source receptacle has voltage present.

Visually check that both (2) fuses located on Laser Controller rear panel, located inside AC Input/AC Fuse Block, have not failed. Fuse rating: Type GMC, 5 x 20mm, 250 VAC, X Amperes, medium time delay.

A short audible “beep” should be heard when the Laser Controller is plugged into the AC receptacle.

System Fails to Initialize / Red ON/OFF indicator illuminates when placed in the ON position:

All LED indicators should blink once with one long, 1 to 2 seconds, audible “BEEP.”

The Laser Controller LCD display should also be back-lighted/illuminated displaying Main Menu.

Laser Intra-cavity Shutter fails to open / “Blinking” green Shutter LED, No laser output:

Note: Reference Appendix, p. 34, V, for shutter functionality.

Verify the presence of interlock connector at Laser Controller rear panel, User I/O connector.

At Laser Controller front panel, visually check that green shutter LED illuminates steadily, and shutter opens, when the shutter button is depressed.

Exercise (Laser Safety) Caution! Place ear on or close to top cover of laser housing and actuate Laser Controller front panel Shutter Switch. An audible sound of the shutter actuating, de-actuating should be heard.

LCD Error Message

SHG Temperature error – These warnings occur when the crystal temperature is outside of, above or below, the operating range.

Laser Diode Temperature error – This warning occurs when the Laser Diode temperature is outside of, above or below, the set temperature operating range.

QSW/Diode Temperature error – This warning occurs when the laser housing temperature is outside of, above or below, the specified laser system temperature operating range.

Operating Precautions

I Standby Operation - Inoperative Periods - Temporary Storage

To avoid deterioration of the SHG crystal in harmonic model lasers, the Laser Controller should always be connected to an active incoming AC line. The AC on/off rocker switch should be left in the off position thereby placing the system in standby mode.

The standby mode maintains the temperature of the SHG crystal at its operating temperature maintaining laser reliability.

II Customers with Multiple DP Laser Systems:

The Laser Controller and Laser Head form a system. Do not interchange Laser Head and Laser Controllers between systems, even if identical in model, revision levels. Calibration differences may result in damage!

III Definition of Warnings / Alarms -

The following warning information could be given:

- Diode Temp
This warning occurs when the laser diode temperature is too high ($>33^{\circ}\text{C}$), or too low ($<5^{\circ}\text{C}$). or when the temperature sensor circuitry is defective.
- QSW/Diode
This warning occurs when the laser housing temperature is too high ($>40^{\circ}\text{C}$) or too low ($<5^{\circ}\text{C}$), of the specified laser system temperature operating range, or when the temperature sensor sensor circuitry is defective.
- SHG
This warning occurs when the SHG crystal temperature is outside of the preset operating range (T_s) by $>\pm 1^{\circ}\text{C}$.

If any one of the above warnings occurs, turn off the laser system, disconnect the AC power, and contact the manufacturer.

Have available the complete Model Number and S/N of the laserhead; XX_XXX.

IV Incoming Electrical Service Considerations and Requirements

For the Laser System to operate stably and reliably, the AC line service that it is connected to, must be protected from power line surges and unregulated voltage variations.

Power Surges –

Power surges can be caused by severe load changes in adjacent systems such as:

The opening or closing of switch contacts under load; short circuit, blown fuses, or lightning.

Voltage Stabilizer/Power Line Conditioner

Unregulated high or low voltage AC line variations, and voltage dips. They should be reduced by placing a Voltage Stabilizer/Power Line Conditioner between the incoming AC line service and the Laser Controller.

V Functionality of EXT GATE – Key-switch, LDD Supply and Shutter

“EXT GATE” Operation – Is selected by the LCD menu selection in “PULSE” GATE INT/EXT.

Setting to EXT, a +5volt level, TTL “high,” will result in laser output at the PRF frequency. When at a TTL “low” level there will be no laser output.

Key-switch, LDD Supply and Shutter - When the key-switch is rotated clockwise, to the ON position, a low level constant d.c. “simmer current” passes through the laser diode to aid in providing a stabilized laser output. The shutter cannot be opened in this “standby-simmer” condition. When the LDD push-button is depressed to ON, the shutter can now be opened, and the laser diode current slowly increased to the operating value for the system.