USER MANUAL

LDD-6000 CW Laser Diode Driver

The LDD-6000 laser diode driver is intended for OEM laser applications using high power diode lasers. It has been designed to be integrated into systems for maximum performance at a cost far below traditional laboratory and scientific diode laser drivers.

The LDD-6000 takes any three phase AC input from 200VAC to 480VAC, 50/60Hz. The output inverter is a state-of-the-art zero voltage switching (ZVS) inverter which permits very high frequency power conversion with minimum losses.

As a diode laser driver, the LDD-6000 power supply acts as a current source and delivers constant current based on the input program signal, Iprogram(+), which is normally 0-10V. An optional RS-232 interface is available. All units are configured with a maximum current and maximum voltage capability, depending on the user's requirements. LDD-6000 will deliver current, as programmed, into any load, providing the voltage requirements of that load do not exceed the maximum rated voltage of the unit. When the required compliance voltage is higher then the maximum rated output voltage of the unit, the unit will limit output current.

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Explanation of Symbols

Hazard: This equipment produces high voltages which can be fatal. Only service personnel of Lumina Power, Inc. are qualified to service this equipment.

High Voltage Present. This power supply produces lethal high voltages. Only service personnel of Lumina Power, Inc., are qualified to service this equipment. Only qualified service personnel are permitted to install this power supply.

LDD-6000 Diode Drivers - Theory of Operation

(Refer to Figure 1)

The LDD-6000 has been designed specifically for the OEM high power CW laser diode systems. OEM power supplies for the laser diode industry have the following requirements:

- Safe laser diode operation
- Broad range of control of output current
- Safe rise/fall times
- Auxiliary power supplies to simplify overall laser system design
- Low conducted electromagnetic emissions

Referring to Figure 1, the "LDD-6000 Laser Diode Driver Block Diagram", the following is a brief description of operation.

AC Input Power Circuitry

Input voltage: 3 phase and GND. No Neutral.
AC input power is processed through a line filter to reduce the conducted EMI to an acceptable level. The LDD-6000 line filter has minimum capacitance to ground to minimize leakage currents. Earth Ground stud is provided near the AC input terminals and should be connected to the system ground.

The LDD-6000 can take any AC input voltage of either 200 – 240VAC or 380 – 480VAC and the internal jumpers have to be selected correctly. The power supply will not fail but will not work if the jumpers are not correctly selected and the red LED near the AC input terminal will be seen and the safety relays will not closed.
Upon applying the mains, the fans will start and the safety relays will close after a delay of a few seconds if the power supply is healthy and ready to operate.

Zero Voltage Switching (ZVS) Inverter

The ZVS inverter and the output transformer are used to step the rectified 3 phase voltage bus to the appropriate output value. The ZVS inverter is the most modern high frequency/low loss/low noise topology utilized in power electronics today. Instead of running the inverter in a traditional PWM mode, the inverter is run in a phase shift mode. With the appropriate output inductor and the appropriate capacitance across each switching device, in this case MOSFETS, there are virtually no switching losses in the inverter. The only losses in the devices are I^2R losses associated with the Drain/Source resistance of the

MOSFETS. Therefore, the ZVS inverter also contributes to reduced losses, reduced EMI noise and a reduction in overall system heat sink requirements.

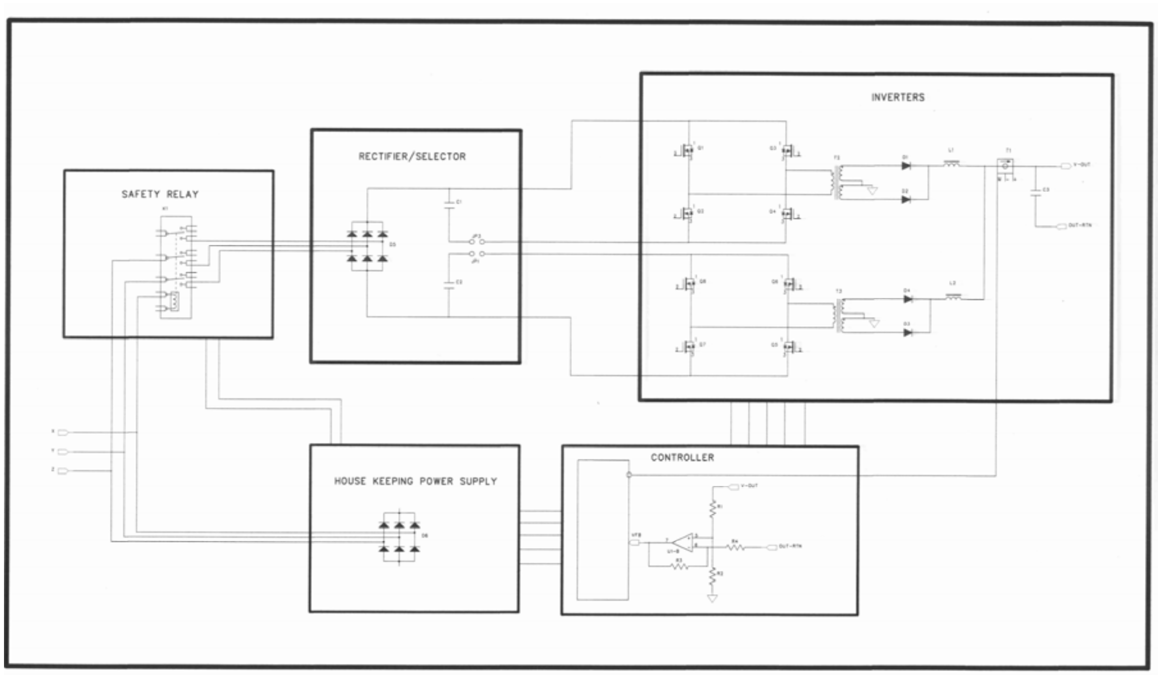
Output Circuit

The output filter is a two stage LC filter designed to keep ripple and output noise very low. The filter has very small capacitors to prevent high current spikes in case part of the laser diode array fails shorted.

Control Circuit

The control circuit handles all the responsibilities associated with safe operation of the laser diode. Controlled rise and fall times, as well as tight current regulation, overvoltage and over power protection are controlled and monitored in the control circuit.

Figure 1
Block Diagram



LDD-6000 SPECIFICATIONS

Model	$Pout_{max}$	Output Current	Input Voltage	Size (L x W x H)
LDD-6000-XX-YY	6500W	Up to 300A	200-480VAC	17.3” x 16.6” x 3.75” 44cm x 42.2cm x 9.5cm
Where XX = $Iout_{max}$ YY = $Vcompliance_{max}$ XX * YY cannot exceed 6500W				
Auxiliary Outputs: +5V @0.2A, +15V @0.2A, -15V @0.2A				

Input

Voltage:	200 – 240VAC and 380 – 480VAC, 47-64Hz 3 phase, jumper select.
Current	19A per phase @ 200 and 10A per phase @ 380VAC.

Interface

Connector:	15 Pin “D” Sub Female
Current Program:	0-10V for 0-Max Current
Current Monitor:	0-10V for 0-Max Current
Voltage Monitor:	0-10V for 0-Max Voltage

Performance

Max Rep Rate:	500Hz
Rise/Fall Time:	~1msec standard, 600usec – upon request (10% to 90% Full Current)
Current Regulation:	0.5% of Maximum output current
Current Ripple:	<0.5% of maximum output current
Current Overshoot:	<1% of maximum output current
Power Limit:	Limited to maximum power with power fold-back circuit

Environment

Operating Temp:	0 to 40 ^{o}C
Storage:	-20 to 85 ^{o}C
Humidity:	0 to 90% non-condensing
Cooling:	Forced air

Regulatory

Leakage Current:	<1800uA Normal Fault <3600uA Single Fault

LDD-6000-XX-YY Interface

(Where XX = Iout max, and YY = Voutmax)

Connector Type: 15 pin D-sub Female

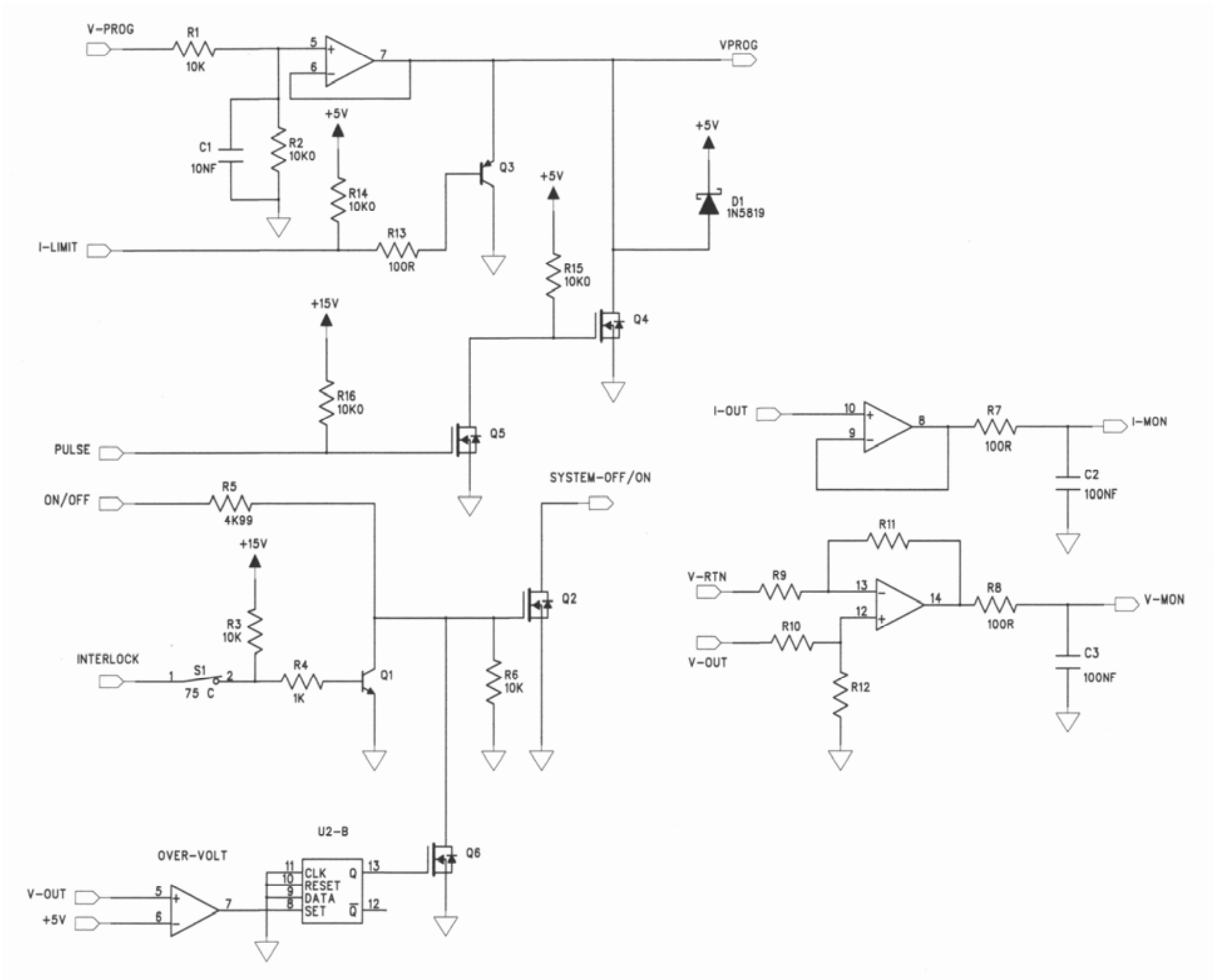
(Refer to Figure 2, LDD-6000 Interface Schematic)

Pin #	Pin Name	Functional Voltage Level	Description
1	**Enable** (input)	High = RUN = +5V to +15V Low = OFF = 0V	The **Enable** function turns the output section of the power supply ON and OFF. When the power supply is enabled, current is delivered to load as programmed via **Iprogram(+)**, Pin 7. Rise times resulting from **Enable** are approximately 25msec.
2	**Current limit** (input)	0-10V = 0 – 105% allowed output current. Default = 105%	Limit output current programmed at I-Program, pin 7.
3	**Interlock** (input)	Open = OFF Connect to GND = RUN Voltage must be less than 0.3V for Low.	The **Interlock** function can be connected to external interlock switches such as doors or over-temp switches. It is gated by a thermal switch internally to protect the power supply against over temp.
4, 9	GND		Referred to (-) output of power supply.
5	**Vout Monitor**: (output)	0 – 10V = 0 – $Vout_{max}$	The output voltage of the supply can be monitored by **Vout Monitor**.
6	**Iout Monitor** (output)	0 – 10V = 0 – $Iout_{max}$	The output current of the supply can be monitored by **Iout Monitor**.
7	**Iprogram(+)**: (input)	0 – 10V = 0 – $Iout_{max}$ Internally limit at 10.5V.	The power supply output current is set by applying a 0-10V analog signal to **Iprogram(+)**. **Note: Accuracy will be compromised when operating below 30% of the maximum value.**
8	**Pulse Control** (input)	TTL High = On TTL Low = OFF **Default = On**	The output may be pulsed OFF by applying a <u>TTL 0</u> to **Pulse Control**, pin 8. When a <u>TTL 1</u> is applied to pin 8, or left open the amplitude of the output current pulse is determined by the current level programmed via Pin 7, **Iprogram(+)**. Rise fall times of 1msec are typical. **The default condition is ON, which permits CW operation with no connection to Pin 8.**
10,11	**+5V @ 0.2A** (output)	5V ± 10%	Auxiliary +5V power supply for user. Up to 0.2A output current capability.
12	**-15V @0.2A** (output)	-15V ±10%	Auxiliary -15V power supply for user. Up to –0.2A output current available.
13,14	**+15V @0.2A** (output)	15V +/- 10%	Auxiliary +15V power supply for user. Up to 0.2A output current available.

Table 1: LDD-6000 Interface Pin-out

Figure 2

LDD-6000 Interface Schematic



INSTALLATION AND OPERATION OF LDD-6000 Diode Drivers

IMPORTANT INSTALLATION NOTES

- The LDD-6000 diode driver is air cooled by internal fans. Do not restrict air flow near the input or output air vents of the power supply. If the unit overheats due to restricted air flow, it will shut down and remain off until the unit has cooled to a safe internal operating temperature.

1. **Installing the power supply**. Refer to Figure 4, the LDD-6000 Outline Drawing. There are two 8-32 threaded PEM holes on both sides of the power supply which can be used to mount rack slides. Also, there are four 10-32 threaded PEM holes on the bottom of the supply for mounting purposes. The mounting screws should not penetrate the power supply more than 1/4"

SAFETY WARNING

Because LDD-6000 is designed for OEM applications, the user must connect AC input power to the power supply AC Input terminal strip. Any input AC voltage must be considered extremely dangerous, and as such, care must be taken to connect AC input power to the unit.

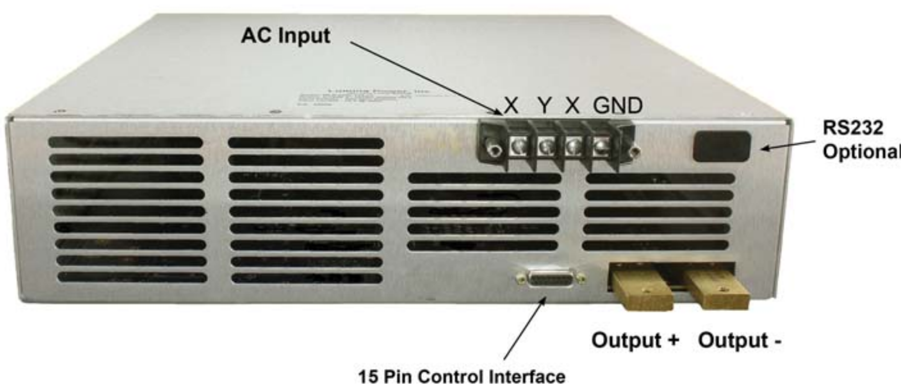


Figure 3
LDD-6000 Input Connections

1. **CONNECTING TO DIODE LASER** Figure 3 shows the location of the LDD-6000 output terminals. Connect diode laser load to the output terminals. Although CW diode laser applications are generally free of voltage spikes associated with

high speed Quasi-CW applications, it is still good practice to keep connections between the diode laser and power supply as short as possible to minimize inductance and avoid I^2R losses in the wire.

2. **INTERFACE CONNECTION** Connect user interface to Analog Interface 15 pin D-sub connector shown in Figure 3. (Although this interface is typically designed by the user, Lumina Power can provide any assistance necessary to modify interface program and monitor levels) See Table 1 and related schematic for a description of the LDD-6000 Interface Pin-out.

IMPORTANT NOTE

Make sure when connecting interface that the current program setting, **Iprogram(+)**, is set no higher then the value required for operation. When AC power is applied and system **ENABLE** is applied, output current will rise to this program value

3. **AC INPUT POWER CONNECTION** Connect AC power connections to power supply input power terminals as follows (refer to Table 2 and Figure 3.):

MODEL	INPUT POWER
LDD-6000-XX-YY	200-240 or 380 - 480 VAC, 50/60 Hz,

Table 2 LDD-6000 Input Power

- AC Connections (#12AWG) are connected to the terminal strip connections shown in Figure 3.
- Ground wire (#12AWG) is connected to the terminal strip connections shown in Figure 3.

IMPORTANT APPLICATON NOTE REGARDING AC INPUT POWER

AC Input wires should be at least #12 AWG, rated for at least 600V and 105 Degree C.

IMPORTANT SYSTEM NOTE ON AC INPUT POWER

LDD-6000 units are fused on X,Y & Z Phases.

4. **APPLY INPUT AC POWER** Turn ON AC power. After a few seconds the power supply fans should begin to run.
5. **PROGRAMMING OUTPUT CURRENT** Program LDD-6000 power supply for desired output current. A 0-10V signal applied to interface pin 7 (see Table 1) will program the LDD-6000 diode driver for 0 to maximum rated output current.

IMPORTANT APPLICATION NOTE

When the power supply is enabled using the ENABLE signal, internal soft start functions limit the rise time of the output current to approximately 25msec. Once the power supply is enabled, the rise/fall time of the Iprogram(+) signal is approximately 2msec. Slower rise/fall times are available upon request. A rise/fall time of 2msec does not typically result in dangerous voltage spikes on the diode laser.

6. **ENABLE Output** Enable LDD-6000 power supply by applying +5 to +15V to ENABLE Pin 1 or 2 (see Table 1.). Current will now be delivered to laser diode as programmed.
7. **Current Monitor** Power supply output current can be monitored via pin 6 (see Table 1). A 0-10V signal will represent the output current from 0 to maximum rated output current.
8. **Voltage Monitor** Power supply output voltage can be monitored via pin 5 (See Table 1). A 0-10V signal will represent the output voltage from 0-maximum rated output voltage.
9. **Pulsing** The LDD-6000 laser diode driver is designed for CW applications. However due the fast response achievable with very high frequency switchmode power supplies, it is possible to pulse this unit at sub-Quasi-CW speeds. The typical rise and fall times of the LDD-6000 is ~ 1msec, but can be configured for rise times as fast as 0.6msec. Therefore, pulsing at frequencies up to 500Hz is possible. Pulsing can be accomplished with the **Pulse Control** function, Pin 8 (see Table 1). When Pin 8 is grounded, an internal circuit defeats the **Iprogram** signal. When Pin 8 is High, **Iprogram** is delivered to the control system as programmed. When no connection is made to Pin 8, the **Pulse Control** function is internally set HIGH, permitting CW operation. The **Pulse Control** function is much faster than the **ENABLE** function, which has a soft-start function.

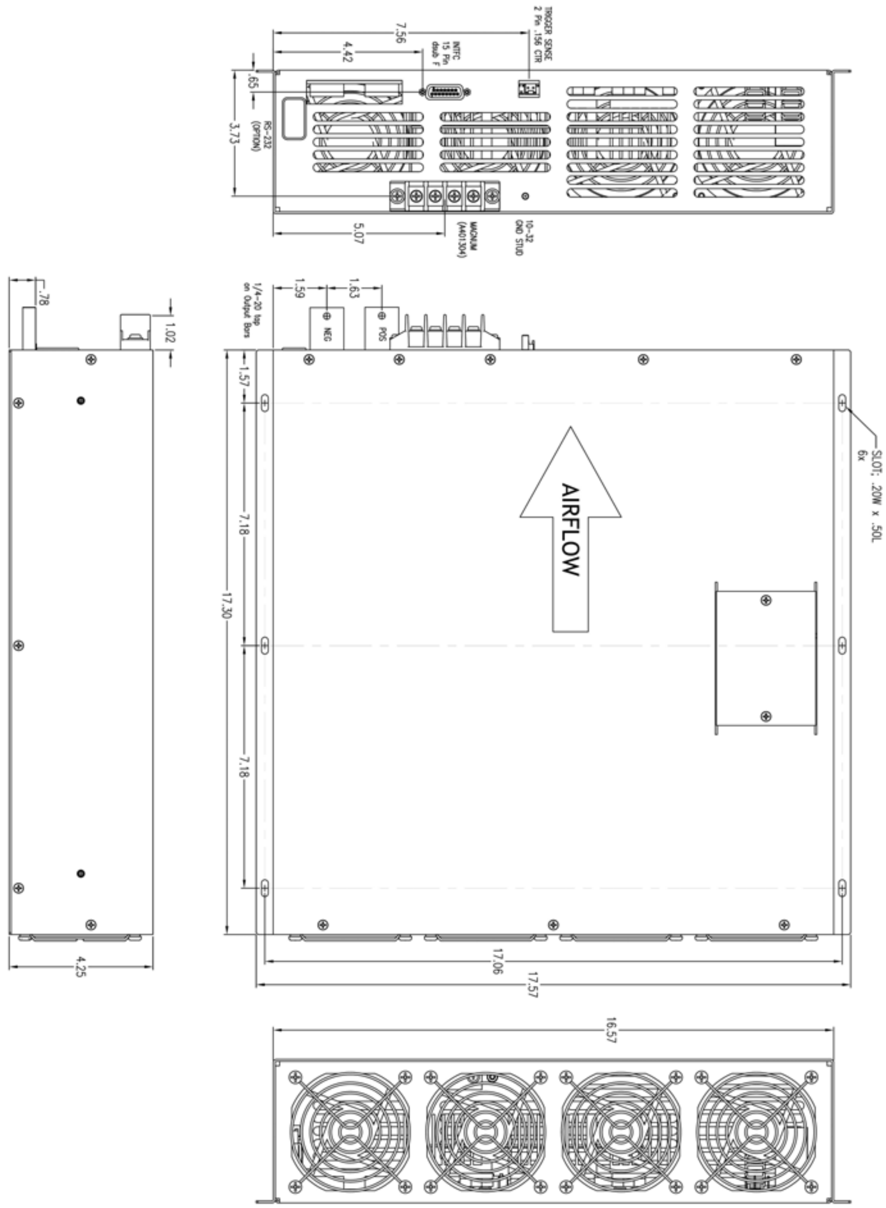


Figure 4. LDD-6000 Mechanical Outline Drawing

Servicing LDD-6000 Diode Drivers

LDD-6000 units has no serviceable parts. Do not attempt to repair or service this unit in the field.
For further information, contact Lumina Power at 978-241-8260.

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