USER MANUAL

MLB/XLB-6500 Short Arc Mercury/Xenon/Xenon Lamp Ballast

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Product Overview

The MLB/XLB-6500 Mercury/Xenon lamp ballast is a very compact power supply designed for Mercury or Xenon lamp OEM applications. The MLB/XLB-6500 is ideal for high power applications where economy is important and performance cannot be compromised. Compact size is possible due to a low-loss Zero Voltage Switching inverter and incorporation of planar magnetics. No additional line filter is required to meet EN 55011 emission requirements. Lumina Power's MLB/XLB series sets the standard for reliable lamp ignition and long term high power operation in a low cost, compact package.

As a Mercury lamp ballast, the MLB-6500 power supply first ignites the lamp with a high voltage pulse and, once the lamp is ignited, acts as a programmable power source delivering constant power based on the input program signal, Pprogram(+), which is normally 0-10V.

As a Xenon lamp ballast the XLB-6500 ignites the lamp in the same way as the MLB -6500 but once the lamp is lit the XLB-6500 outputs a constant current based upon the input program signal Iprogram which is normally 0-10V

The MLB/XLB-6500 can be configured for maximum current up to 200A and maximum voltage up to 150V.

The MLB/XLB-6500 utilizes a proprietary low loss, state-of-the-art zero voltage switching (ZVS) inverter which permits very high frequency power conversion with minimum losses and electromagnetic noise.

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.

MLB/XLB-6500 Theory of Operation

(Refer to Figure 1)

The MLB/XLB-6500 Mercury/Xenon lamp ballast has been designed to drive high power Mecury/Xenon arc lamps. OEM power supplies for Mercury/Xenon arc lamps must have the following requirements:

- Safe lamp operation
- Reliable short pulse lamp ignition
- Compact size
- Conform with CE requirements
- Low conducted electromagnetic emissions
- Ability to operate on all world input voltages

Referring to the Figure 1, "MLB/XLB-6500 MERCURY/XENON LAMP 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 CCHP-6500 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 MLB/XLB 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 close.
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 convert the rectified 3 phase voltage down 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

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, reduce EMI noise and a reduction in overall system heatsink requirements.
The inverter also generates the boost voltage for lamp ignition. Boost voltage is superimposed on top of the main output and has very high output impedance and will collapse when the lamp is lit.

Output Circuit
The output filter is 2 stage RC filter designed to keep ripple and output noise very low.

Control Circuit
Mercury/Xenon lamps have a very dynamic impedance characteristic and the power supply will work on constant power for Mercury lamps and either in constant power or current mode for Xenon lamps to allow the voltage and current to self-adjust based on instantaneous impedance.
Difference between Mercury and Xenon lamps requires difference control circuit of the power supply but it can be selected autonomously.

Xenon lamps act as a constant voltage load and thus the power supply can operate in power or current mode.

The Mercury lamps start up at low voltage and they require high current to heat up the lamp and vaporize the Mercury and build up pressure so that the voltage can increase. The control circuit handles all the responsibilities associated with safe operation of the Mercury lamp. The power supply will start up with minimum default current at about 25% of max rated power and will transition to max current allowed and then switch to power regulation once the lamp voltage increases such that the product of current and voltage is equal to the programmed power at pin 7.
Pin 7 represents either power or current program based on the Power/Current selection switch and 10V = Full Scale.

Reliable lamp ignition as well as tight power regulation, overvoltage and over power protection are controlled and monitored in the control circuit.
Power supply will try to start the lamp with continually ignition pulses but will latch off after 5 seconds if lamp is not lit.

Lamp Igniter Module
The igniter module provides the required pulse up to 40kVto break down the lamp gas and facilitate ignition. In standard configurations, the pulse is applied through the positive output to the lamp anode. Power to the module is provided by the main power supply chassis. Internal circuitry in the igniter module senses the ignition and briefly disables operation in the main power supply chassis in order to minimize damage from high voltage noise.
DC igniter is available for noiseless ignition.

Power supply is disabled when the trigger sense cable is not connected.

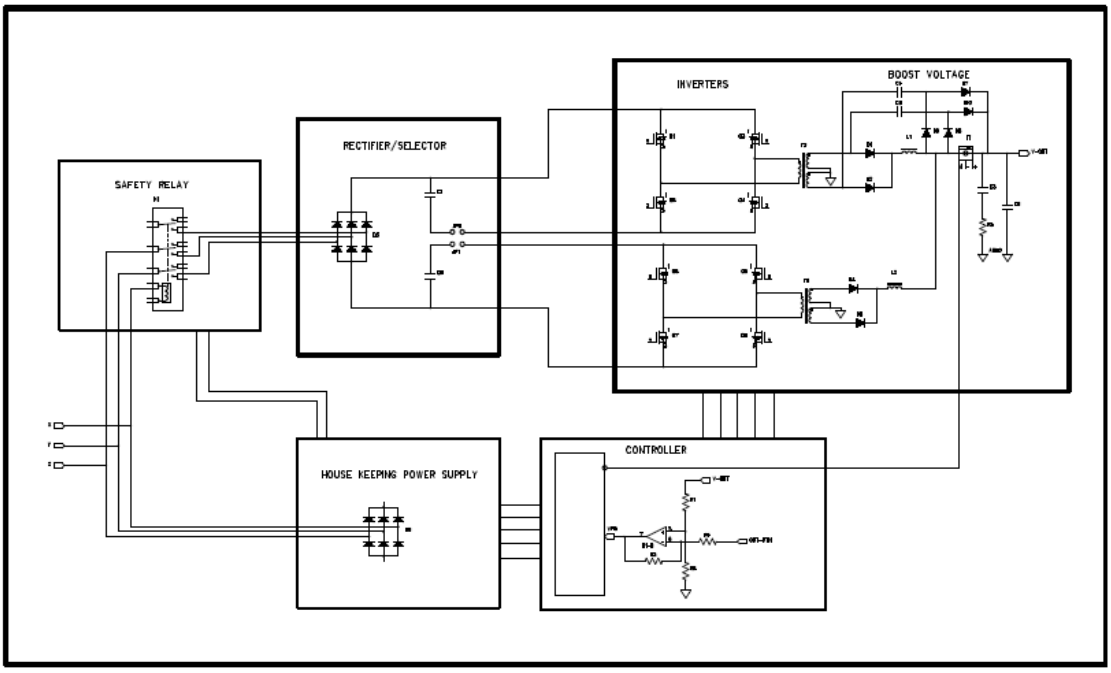


Figure 1
MLB/XLB-6500 BLOCK DIAGRAM

MLB/XLB-6500-XX-YY SPECIFICATIONS

XX = $Iout_{max}$ YY = $Vout_{max}$ XX * YY cannot exceed $Pout_{max}$

Model	$Pout_{max}$	Output Current	Input Voltage	Size (L x W x H)
MLB/XLB-XX-YY	6500W	Up to 200A	200-240VAC 380-480VAC	17" x 16.6" x 3.7" 43.2cm x 42.2cm x 9.4cm
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	23.5 A per phase @ 220 and 11.6A per phase @440VAC.

Interface (See interface schematic and description)
Connector: 15 Pin "D" Sub Female

Ignition/Boost

Boost Voltage:	200V
Boost Energy:	500 mJ
Ignition Voltage:	Up to 40kV (~1uSec rise time)
Igniter Polarity:	Positive or Negative (Factory Set)
Ignition Energy:	65mJ
Igniter Dimensions:	7.0" x 4.6" x 3.5"
	178 x 117 x 89mm

Performance

Line Regulation:	<0.2% of maximum output power
Current Regulation:	<0.5% of Maximum output current
Current Ripple:	<0.5% of maximum output current
Power Limit:	Limited to 105% of maximum power rating

Environment

Operating Temp:	0 to 40 °C
Storage:	-20 to 85 °C
Humidity:	0 to 90% non-condensing
Cooling:	Forced air

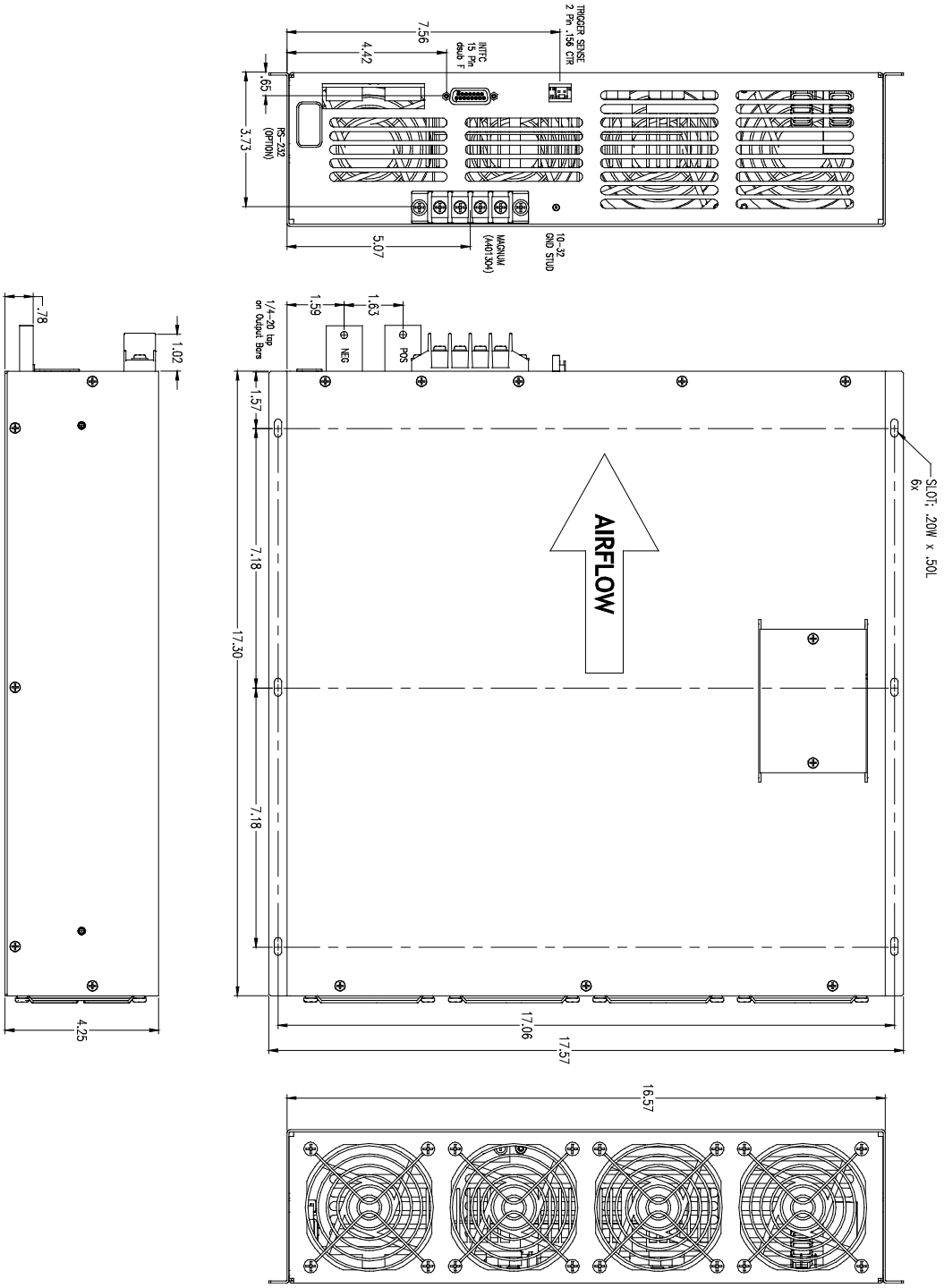


Figure 2
MLB/XLB-6500 Chassis Outline Drawing

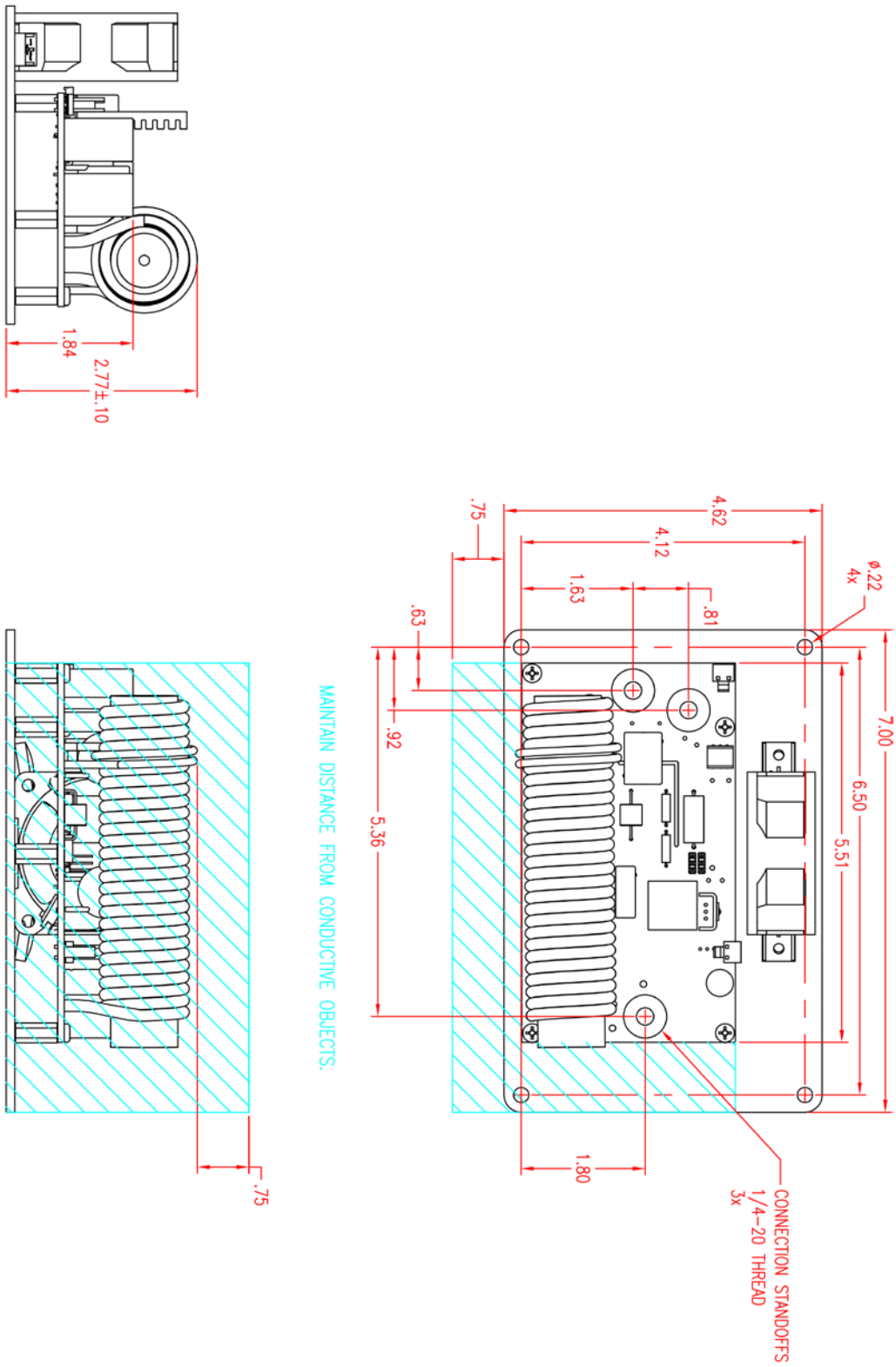


Figure 3
MLB/XLB-6500 Igniter Outline Drawing

MLB/XLB-6500-XX-YY Interface

Connector Type: 15 pin D-sub Female

(Refer to MLB/XLB-6500 Interface Schematic)

Pin #	MLB/XLB-6500 Pin Name	Functional Voltage Level	Description
1	**ENABLE** (input)	High=RUN=+5V to +15V Low = OFF = 0V	The **Lamp On/Off** function is the control function which turns the lamp on and off. When the lamp is turned on, a trigger and boost sequence will ignite the lamp and deliver power as programmed via **Pprogram**, Pin 7.
2	**Current Limit Program (MLB only)**	0-10V = 0- $Iout_{max}$	Maximum output current can be limited to a value less than 105% of the rated output current. 0 – 10V = 0 – 100% rated current. If pin 2 is left open, maximum output current is 105% of rated current.
3	**Interlock** (input)	Open = OFF Connect to GND = RUN	The **Interlock** function can be connected to external interlock switches such as door or overtemp switches.
4, 9, 15	**GND**		
5	**Vout Monitor**: (output)	0 – 10V = 0 – $Vout_{max}$	The output voltage of the supply can be monitored by **Vout Monitor**. After the lamp has lit.
6	**Iout Monitor** (output)	0 – 10V = 0 – $Iout_{max}$	The output current of the supply can be monitored by **Iout Monitor**.
7	**program**: (input)	XLB model 0 to 10V= 0 to $Iout_{max}$ MLB Model 0 to 10V= 0 to Full Power	Lamp output current/power is set by applying a 0-10V analog signal to **program**. At turn on, the I-Program at pin 7 is grounded and the lamp will run with minimum current set internally, about 25% of the rated current. Once the Lamp-On signal is On, the I-program at pin 7 will be connected to control system and will control the output. Because the initial voltage in the Mercury lamp is low, the power supply will run at maximum current until the power loop takes over on the MLB version. The XLB series will output high current as soon as the lamp ignites Output power is limited to about 25% of max rated even the program signal is set to 0V.
8	**Lamp On/Off Status** (output)	Low = Lamp On = 0V High = Lamp Off = 15V	The lamp status is monitored and if at least 20% of the rated current of the power supply is flowing through the lamp, the **Lamp On/Off Status** signal will be pulled low. When the lamp is off, this pin is pulled high to 15V through a 10K resistor.
10,11, 12	No connection Do not connect		
13,14	**+15V @0.20A** (output)		Auxiliary +15V power supply for user. Up to 0.20A output current available.

TABLE 1: MLB/XLB-6500 Interface

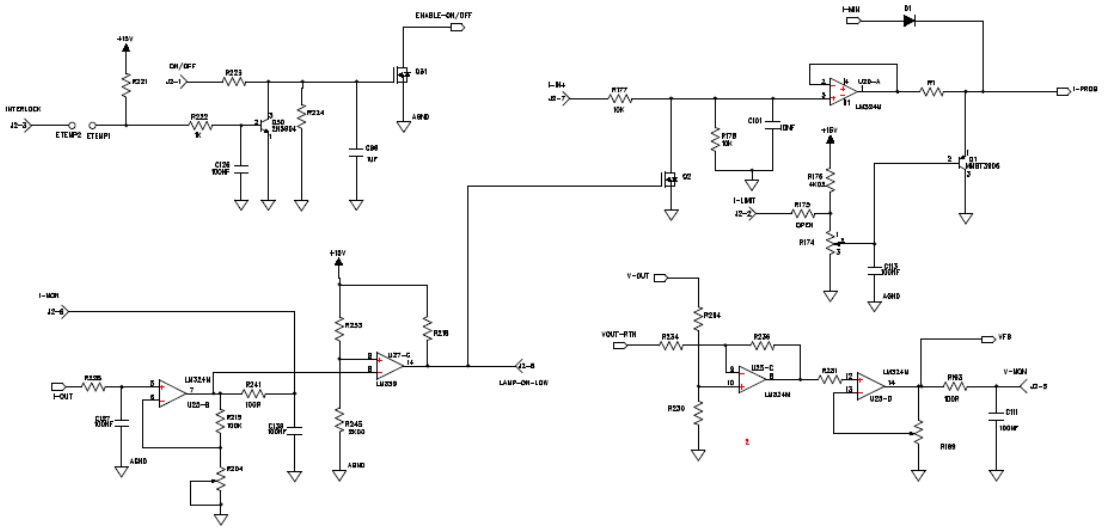
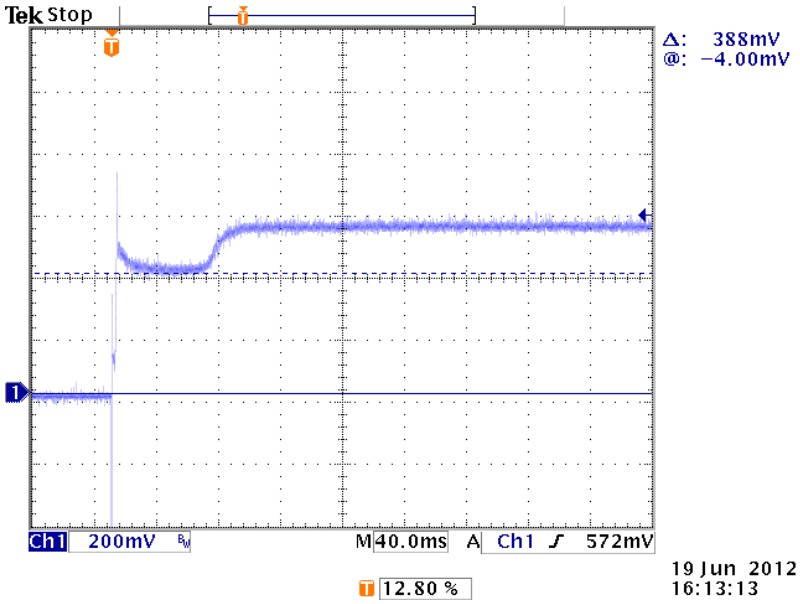


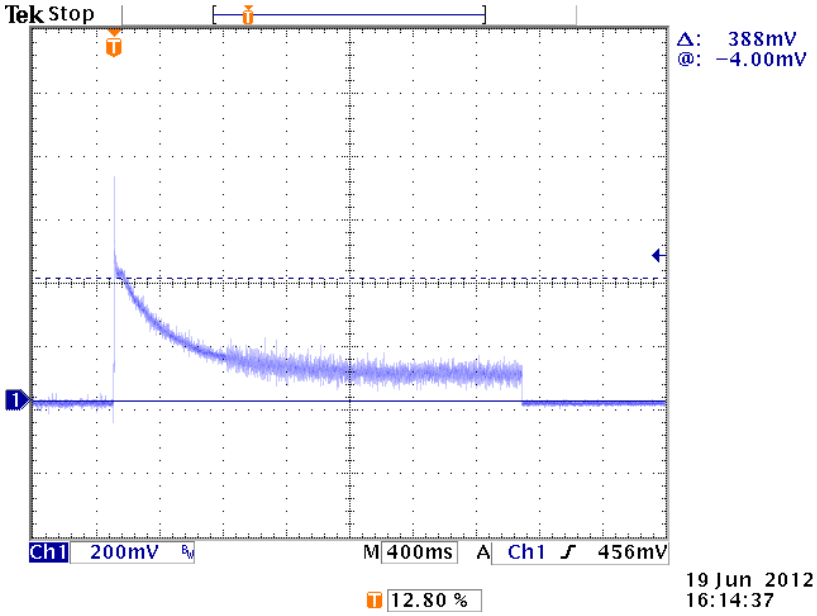
Figure 4
MLB/XLB-6500-XX-YY Interface Schematic

Lamp Current profile:

The XLB power supplies are designed for reliable ignition, knowing that the igniter radiates lots of noise and can destroy neighboring electronics circuits.
Upon the request for ignition, the power supply sets itself at about 40% of its rating current. This ignition current will last for about 100ms and will switch over to the programmed current by the customers' input. If the programmed voltage is less than 20% of the rating current, the power supply will operate at its minimum pre-set of 20 – 25% of its rating current. This will not allow the lamp to extinguish and the ignition cycle will re-start. The only way to turn OFF the lamp is by the Enable and Interlock signals.



I-Program is higher than ignition current which is 40%.



I-Program is set at 0V at ignition.

Installation and Operation of MLB/XLB-6500

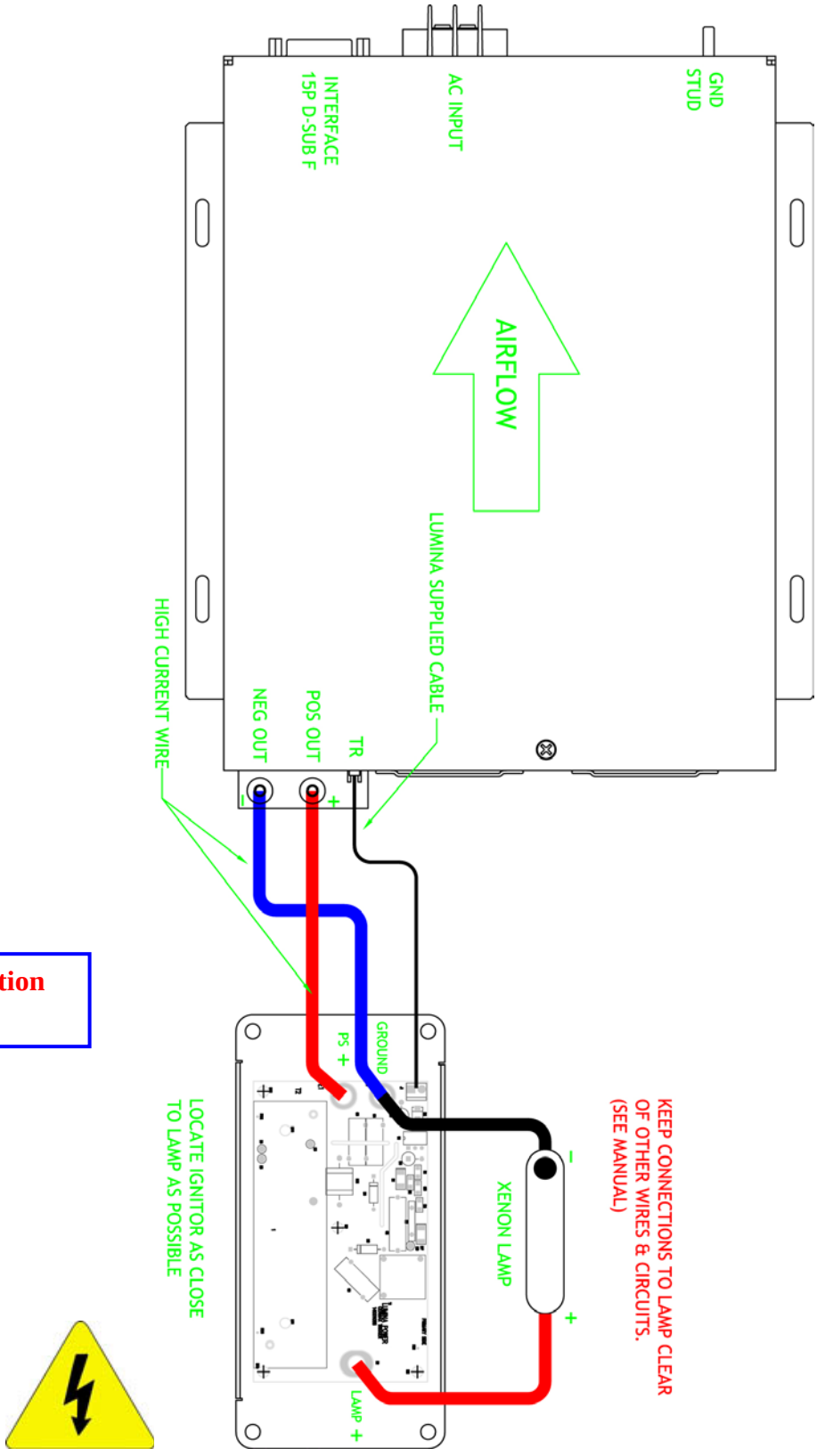
The MLB/XLB-6500 chassis is mounted using the mounting brackets as shown in Figure 2, the MLB/XLB-6500 Outline Drawing. The MLB/XLB-6500 Igniter module has a mounting plate shown in Figure 3.

IMPORTANT HIGH VOLTAGE INSTALLATION NOTE

- The MLB/XLB-6500 system trigger module produces a pulse up to 45kV during lamp ignition. The igniter module should be placed as close as possible to the lamp in order to keep the leads between the igniter and the lamp as short as possible. No other wires should be in the vicinity of the igniter output wires connecting to the lamp. The HV pulse produces transients that can be destructive to low signal electronics.
- Please refer to Figure 3, MLB/XLB-6500 Igniter Outline Drawing, for information regarding required clearances around the high voltage igniter coil.

SAFETY WARNING

Because MLB/XLB-6500 units are designed for OEM applications, the user must connect AC input power to the power supply chassis. Any input AC voltage must be considered extremely dangerous, and as such, care must be taken to connect AC input power to the unit.

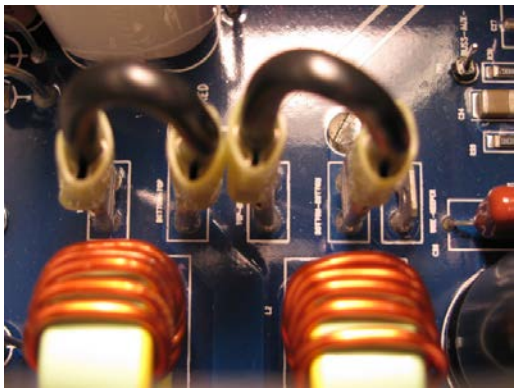


Note: Negative ignition is available

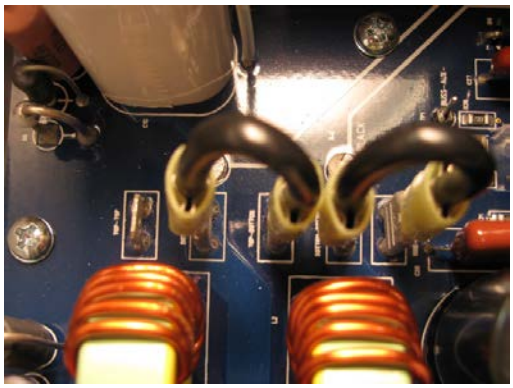
Figure 7
MLB/XLB-6500 Lamp Connections

Connecting AC Inputs: The MLB/XLB power supplies are designed to have selectable input voltages between 200-240VAC or 380-480VAC. This is accomplished by jumper wires located inside the unit.

1. First step is determined if adjustment is necessary by checking the factory configuration label just above the jumper configuration access cover. If adjustment is necessary, remove cover and change jumpers as indicated in the next two pictures.



200 240 VAC input jumper configuration



380 to 440 VAC input jumper configuration

2 **Connecting to Mercury/Xenon Lamp:** Figure 7 shows the interconnections between the MLB/XLB-6500, the Igniter module and the Mercury/Xenon lamp. The igniter module can be located far away from the power supply as long as the output cables can handle the IR loss but it is important to keep connections between the igniter module and the lamp as short as possible because the igniter module produces a high speed 40kV pulse when igniting the Mercury/Xenon lamp, has more chance to arc to neighboring conducting materials and has more capacitance to load down the trigger pulse. The Igniter module is ideally placed as close as possible to the lamp. Use high voltage wire for connection between igniter output and lamp anode and dress the high voltage wire away from any metallic material to avoid arcing.

3 **TR Trigger Sense Connection:** Connect the TR trigger sense connection wire between the trigger module and the MLB/XLB-6500 main power supply chassis. The cable for this connection has been provided. The location of the connections is shown in Figure 7.

IMPORTANT NOTE

Make sure when connecting interface that the power (MLB) or current (XLB) program setting, **program(+)**, is set no higher than the value required for lamp operation. When AC power is applied and system is Enabled via **Lamp On/Off**, output current will rise to this program value.

4 **Interface Connection:** Connect user system to Interface 15 pin D-sub connector shown in Figure 5. (Although the user 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 Figure 4 for description of MLB/XLB-6500 Interface and the associated simplified interface schematic.

5 **Interface Information before applying AC Power:** The unit may be programmed for output power via Pin 7, the **Pprogram** function. But there are three interface control signals which must be properly set before the output will deliver current as programmed by Pprogram.

a. **Interlock:** Pin 3, the **Interlock,** must be grounded via Pins 4, 9 or 15 in order for the output to deliver current. Users typically wire system interlock switches in series with this interlock connection.

b. **Lamp On/Off**: Pin 1, the **Lamp On/Off** signal is a 5V to 15V signal used to turn the output section on after application of AC power.

c. **Pprogram:** Pin 7. A 0-10V signal results in 0 to $Pout_{max}$, as long as the rated compliance voltage of the driver is not exceeded. Note that after the lamp is turned on via **Lamp On/Off**, the output current will be at the max rated current, or current limited by pin 2 until power loop takes over. This current surge will last up to ten minutes or until the lamp reaches thermal equilibrium. Because the lamp voltage is initially low before reaching thermal equilibrium, lamp power is not exceeded.

6 Operating the MLB

Connection	Description	Required Wire and Connectors
AC Input Power	4 Position terminal strip	At least 12AWG wire
Interface	15 pin "D" female	15 pin "D" male
Output wires (Larger wires required if longer than 3 feet)	Power supply to Trigger Module and Trigger – to Lamp Cathode	50-70 Amp: # 8 70 – 100Amp # 6 100-130 Amp # 4 130 -170 Amp # 2
Output wires (Larger wires required if longer than 3 feet)	Trigger+ to Lamp Anode	50-70 Amp: # 8, 40kV 70 – 100Amp # 6 40kV 100-130 Amp # 4 40kV 130 -170 Amp # 2 40kV

IMPORTANT SYSTEM NOTE ON AC INPUT POWER

MLB/XLB-6500 units are fused on all input lines. Wiring can be done with any of the phases to X, Y, Z. Connect ground wire only. No neutral wire

IMPORTANT APPLICATON NOTE REGARDING AC INPUT POWER

AC Input wires and Earth Ground wire should be at least #12 AWG, rated for at least 300V and 105 ^{o}C.

a. **Interface Settings**: Make sure **Interlock**, Pin 3, is connected to GND.
b. **Apply Input AC Power:** Turn ON AC power. After a few seconds the power supply fans will begin to run.
c. **Programming Output Power:** Program MLB/XLB-6500 power supply for desired output power. A 0-10V signal applied to **Pprogram**, Pin 7, will program the MLB/XLB-6500 for 0 to maximum rated output power. Pin 7 is not active when its level is lower than 2V as the power supply is pre-set to output about 20% of output power when ON.
d. **Lamp On/Off** Apply +5V to +15V to **Lamp On/Off**, Pin 1. The lamp will ignite providing Interlock pin is Low.

7 Monitoring MLB/XLB output and performance:

a. **Current Monitor** Power supply output current can be monitored via pin 6, **Iout Monitor**. A 0-10V signal will represent the output current from 0 to maximum rated output current.
b. **Voltage Monitor** Power supply output voltage can be monitored via pin 5, **Vout Monitor**. A 0-10V signal will represent the output voltage from 0-maximum rated output voltage.
c. **Lamp On/Off Status** Once the lamp has successfully ignited and at least 20% of the maximum rated current of the power supply is being delivered to the lamp, the LAMP ON/OFF Status signal will go low

- Ventilation:
  Unit is forced air cooled via internal DC fans. A clearance of 2" should be maintained at either side of the power supply the fan end of the power supply as well as the grill side of the power supply. Hot air exits the grill side and should be routed out of the system.

8 Servicing the MLB/XLB-6500:

XLB-6500 units have no serviceable parts. Do not attempt to repair or service this unit in the field. Removing tamper seals from chassis will void warranty. For further information, contact Lumina Power at 978-241-8260.

Rev	ECO	Description	Date	Doc Control
1	7062	Release	11/16/11	MJ

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