Instruction Manual

Comment [M1]: Instruction Manual V4.0

High Power Super Pulse & Ballastless Multi-Output CO_2 Laser Power Supply

Models:
CPZ-50/150, CPP-600, CPF-600/1000, CPF-600WOM, CNF-600P/WOM, CSF-1200/2000/3400/ 4000/8000/25000

This manual contains Operating, Safety, and Maintenance information and subjects to change without notice.

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Comment [M2]:

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1.1 GENERAL

Lic engineering's Ballastless CO_2 laser power supply will produce very high voltage up to 50KV and high currents up to a few thousand mA under certain conditions. This is sufficient voltage and current to kill people. A little careless operation or mishandling may cause a fatal accident.
In order to avoid any such accidents and to ensure the long life designed into this power supply, it is important that all instructions be followed.

1.2 DESCRIPTION

Lic engineering is the one of world leading providers of innovative CO_2 Laser Power supply. Our specialties are for:

1). The most compact CO2 laser power supply,
2). High power water-cooled laser power supply,
3) Multi-output CO2 laser power supply,
4). Ballastless & Super Pulse CO2 laser power supply,
5). Power supply for diffusion-cooled CO2 slab lasers and fast-axial-flow CO2 lasers).
6). High efficient switch mode laser power supply.

Incorporating **BALLASTLESS** technologies, Lic engineering's switch mode CO2 laser power supply can operate without requiring ballast resistors in H.V. lines of the laser head. As a result, total electrical efficiency of the laser system will increase up to 20-30% compared to a conventional type power supply using the ballast resistors.
The Ballastless operation is performed by using drooping characteristic of the secondary multiplier that is carefully designed to achieve Super Pulse and Ballastless operation at the same time.

Ballastless CO2 laser power supply can replace all the bulky H.V X-former, big and expensive oil capacitors, big & expensive H.V rectifiers, H.V ballast resisters that is causing a heat loss of typically 1/3 of total power required for the laser head, and an expensive vacuum tube in some cases.

SUPER PULSE is accomplished by combination of 1). Carefully designed secondary H.V multiplier, 2). Primary high peak current/high frequency switching circuit and 3). Negative impedance of the CO2 laser tube. If a primary switching circuit can push a very high energy into the secondary in short time, then the compressed energy in the multiplier is rapidly released when the secondary high voltage comes to the breakdown point of the laser tube because the tube has a deep negative impedance characteristic. Once the breakdown occurs, the tube impedance is decreased and this causes to increase further the tube current, and thus this cycle accelerate in very short time (avalanche process).
The result is a fast rise time and narrow high peak current that reaches the high peak laser power of **10 times higher than CW**. This is not difficult to achieve with this technology.

Series Resonant Topology

Since the first product was developed in early 1980s, Lic's switch-mode CO2 laser power supply has used the series resonant topology, which make a switching current **"sinusoidal", or "zero-current switching"** to make the switching loss minimal and is able to push a very high current into the secondary circuit in very short time. This sinusoidal switching, or zero-current switching technology makes Lic's products **high efficient, compact**, and **reliable power supply**.

With the same technology, Lic has developed its first compact and high efficiency **"true sine wave inverter"**

Refer to http://www.licengine.com/products/LSP-120.html for detail.

Unique Core Design:

The output transformers are very thin---which makes the flat type and very thin H.V power supply—helps the heat conduction effectively to the water channel and keeps the H.V components (transformers, rectifiers, and capacitors)'s operating temperature low. This results in the highly reliable and the most compact switch-mode CO2 laser power supply.

AZCS (Auto-Zero-Current Switching):

AZCS enables IGBT to switch at almost zero current over the entire operating range. When AC voltage, or load impedance is changed, the AZCS automatically finds an optimum operating condition.

Although AZCS is built in CSF25000-series only, this zero-current switching is used for all Lic models. At maximum power region where the most power dissipation occurs, the switching current becomes sinusoidal so that the switching loss is minimized.

Unique Dry Insulation (except CSF-25000 series):

Biggest problem in the H.V power supply design is to avoid corona that eats the insulating material and gradually the insulating strength decays.

In the dry insulation, the most common way is to use a vacuum impregnation method that H.V components are impregnated with the insulating material under high vacuum condition. The problem with this way is air babbles remained in the insulating material since the viscosity of the insulating material is usually much higher compared to water of 1. Even if the air babbles are very small, this air is ionized under certain strength of the electrical field, and produces O_3(Ozone). Ozone is a powerful oxidizing agent, so it eats the surrounding insulating material all the time as long as the electrical field exists.

Lic's insulating method is quite unique that can eliminate any air babbles remained in the insulating material. With this way, Lic has succeeded that the compact size and high voltage power supply is reliably consistent with.

1.3 SPECIFICATIONS

1.3.1 AC INPUT

100V, 120V, 208V, 220V, 360V, 480V AC Center Voltage: +/- 10%, Single and Three phase, 47-63Hz.

Note: Other voltage ranges are also available by request.

1.3.2 OUTPUT POWER

65W-150W Continuously in CW mode:	CPZ-50P/150PD
600W:	CPP-600
600W/1000W Continuously in CW mode:	CPF-CNF-600/1000P/PD /WOM
2KW/3.4KW Continuously in CW mode:	CSF-2000/3400P/PD/PQ
8KW Continuously in CW mode:	CSF-8000P/PD/PQ
25KW Continuously in CW mode:	CSF-25000PD & /8

1.3.3 STRIKING VOLTAGE

25KV-50KV, depending on the unit ordered.

1.3.4. OPEN CIRCUIT VOLTAGE

When no loads are connected to outputs of the power supply, the unit is capable of producing extremely high voltage that is 3-4 times higher than its striking voltage. This high voltage is protected by a H.V protection circuit, but under certain condition (Floating side in a dual discharge) the H.V protection can not protect the high voltage.

To avoid any such dangerous conditions, it is very important to confirm that all high voltage and floating outputs are connected firmly to the correct loads before producing high voltage.

Note:
Open circuit protection protects only (center) H.V. outputs and does not protect a floating output in dual discharge configuration. In certain circumstances, the floating output may attain very high voltage unless the load is connected properly to the power supply.

1.3.5 OPERATING VOLTAGE

5KV to 35KV, depending on the unit ordered.

1.3.6 OPERATING CURRENT

Maximum allowable current:
50mA to 15 amps, depending on the unit ordered.

Minimum stable current:
As a general rule, the laser head current tends to be unstable with a high impedance laser tube at low current level. The lowest stable current depends on the characteristic of the specific laser head.

With a fast-axial-flow CO2 laser and diffusion-cooled CO2 slab laser, the minimum stable current depends greatly on the specification of the leaser head.
CSF-2000, CSF-3400, CSF-8000, CSF-25000PD, and CSF-25000PD are designed for these lasers.
Contact to factory for detail.

1.3.7 PULSE RATE

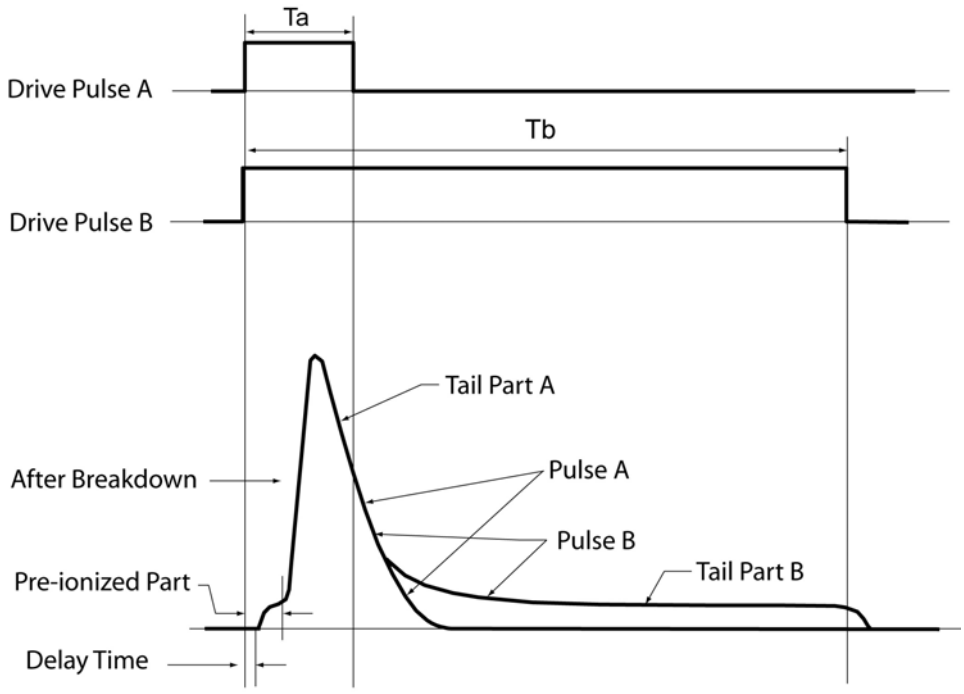
Up to 2KHz to 4KHz, Lic's CO2 power supply can generate the pulse current. As the repetition rate increases, however, the peak height of the laser power will generally be decreased (except those diffusion-cooled CO2 slab lasers and fast-axial-flow CO2 lasers).

1.3.8 PULSE WIDTH

The minimum pulse width is 100uS to 300uS depending on the unit ordered and DC for the maximum. The output current shape is not a rectangular but a kind of exponential curve as shown below. First part of the pulse rises quickly to its maximum, then it decays gradually with the exponential curve. The high peak part of the pulse will last between 100uS and several hundred microseconds, depending on the pulse width setting. When the pulse width is set at 1msecond, for example, the tail part of the pulse is much lower than its peak height as shown in FIG-1.

In the tail part with wider pulse width, that part does not contribute anything to the laser power for the pulse that is higher than CW. Once the high peak power is produced, it take certain time (more than a few hundred uS) to produce next high peak power. The highest power available for this part is only the maximum CW power (except those diffusion-cooled CO2 slab lasers and fast-axial-flow CO2 lasers).

If tube current is exceeded more than the minimum current for the maximum CW power, this part becomes arching very easily.
So the control of the tube current is very important for a stable Super Pulse.



Typical Super Pulse Waveform

(FIG-1)

1.3.9 PEAK POWER

At least 3-4 times higher laser power should be obtained without any adjustment with Lic's power supply. To obtain the 8-10 times higher laser power, the laser tube and the peak current should be optimized. Contact to factory for detail.

1.3.10 AVERAGE OUTPUT POWER IN PULSE MODE

Adjusting pulse conditions by either increasing pulse width or pulse repetition rate will produce an average output power close to CW power.

1.3.11 EFFICIENCY

85% to 94% depending on the unit ordered. With CSF-25000 series that use **AZCS (Auto-Zero-Current Switching) have the highest efficiency up to 94%.**

1.3.12 LINE or LOAD REGULATION

CPP-series (custom made units):

Highly stable, precise version with a pre-regulator attached: +/- 0.1% for 10% change of line voltage or load impedance change. Contact factory for detail.
Also refer to:
http://www.licengine.com/products/special_products.html for detail.

CSF-25000PD & CSF-25000/8:
+/- 0.5% for 10% change of line voltage or load impedance change.

CPZ- ,CPF-, & CSF-series:
+/- 2% for 10% change of line voltage or load impedance change.

1.3.13 PROTECTION CIRCUIT

The protection circuits consist of **IGBT Over Current, Load Over Current, Over Voltage,** and **Over Temperature** as follows.

Over Current Protection Circuits:
protects the unit against (1) Direct or indirect short of H.V. outputs, (2) Any electrical disturbances induced by external or internal noises, (3) Overload caused from improper load (too low or too high impedance). (4) Arcing that could be caused by too high impedance tube, and Super Pulse operation. Most of Lic's products are equipped with (1) Primary (IGBT) over current , and (2) Secondary (Load) over current protection circuit. When the protection circuit detects these fault conditions, the unit will be shut off instantaneously, sending FAULT signal to external.

Over Voltage Protection:
protects the unit against over voltage of H.V. output. When the circuit detects the over voltage condition, the unit will be shut off instantaneously, sending FAULT signal to external.

Note:
Open circuit protection protects only H.V. outputs and does not protect a floating output in dual discharge configuration(Refer to Fig-2). In certain circumstances, the floating output may attain very high voltage unless the load is connected properly to the power supply.

Over temperature protection:
detects a base temperature on which main switching devices and other power semiconductors are mounted. In case the flowing cooling water is insufficient, stopped, or its temperature is not cold enough, this protection circuit will be activated.

Note:
To restart the power supply from the fault condition, use RESET signal. Refer to RESET signal at SECTION 1.4.4 for detail.

1.3.14 OUTPUT CAPACITANCE

CNF-600P & CNF-600WOM have extremely low output capacitance. Major output capacitance of this unit is just the stray capacitance between output cable and grounding. This low output capacitance is essential for stable operation with high impedance tube.

1.3.15 LEAKAGE CURRENT

55uA typical for CPF-600/1000 (Medical Grade). Based on UL(BRH) standard.
For other units, please contact to Lic.

1.3.16 OPERATING TEMPERATURE

Cooling water temperature:	below 25-35C
Ambient temperature:	below 45C

1.3.17 WATER FLOW REQUIRED

CPF-600/1000:	0.2 gallon per minute
CSF-2000/3400:	0.5 gallon per minute
CSF-8000:	0.7 gallon per minute
CSF-25000P/8:	1.35 gallon per minute

Regular Tap Water can be used. The water channels are at ground potential and the material is copper.
Water Connection: ¼" NPT inlet/outlet (apply for CPF-600P/PD/WOM, CSF-2000/3400/8000) and 3/8" NPT inlet/outlet (apply for CSF-25000PD/8)

1.3.18 STORAGE TEMPERATURE

-55C to 70C

1.3.19 DIMENSIONS (inch)

CPZ-50:	5.7(L) x 1.9(W) x 1.3(H)
CPZ-150:	7.7(L) x 1.9(W) x 1.3(H)
CPF-600/1000:	11.4(L) x 3.70(W) x 2.05(H)
CPF-600WOM:	4.8(H)x3.2(W)x7.5(D) inch
CNF-600P:	11.4(L) x 3.70(W) x 2.65(H)
CNF-600WOM:	4.8(H)x7.5(D)x5.3(W)
CSF-2000:	2.78(H)x8.70(W)x11.50(L)
CSF-3400:	2.73(H)x10.60(W)x14.50(L)
CSF-8000:	2.10"(H)x11.30"(W)x18.70"(L)
CSF-25000:	19.2(D) x 12.5(H) x 3.4(W)
CSF-25000/8:	23.80(D)x14.5(H)x5.4(W)

1.4.20 WEIGHT(Lb.)

CPZ-50:	2.1
CPZ-150:	4.7
CPF-600/1000:	5.6
CPF-600WOM:	6.8
CNF-600P:	7-15 (depends on the max. output voltage)
CNF-600WOM:	7-15 (depends on the max. output voltage)
CSF-3400:	17.5
CSF-25000:	68
CSF-25000/8:	80

1.4 CONTROL SIGNAL

Lic's CO2 laser power supplies use 9, 12, and 25 signals to control and monitor the power supply. These signals are completely isolated from an internal main AC line and **GND line is connected to system ground(earth GND).** The control signals are **active-high logic** as described below:

1.4.1 LASER signal (INPUT) for all model

Laser signal controls output(s) of the power supply to be either ON or OFF. In Pulse mode, a modulated pulse train will be inputted. Whenever LASER is high, the power supply will produce a high voltage from its output.

CAUTION:
If LASER signal is high during starting period of the power supply, high voltage output will appear suddenly as soon as READY comes. This could be dangerous under certain conditions. To prevent such accidental high voltage, **keep LASER off before applying AC power to the power supply.**

1.4.2 CW/Pulse signal(INPUT) for CPZ-series, and CSF-25000/50000 only

This signal is used to select either CW mode or Pulse mode. When this is high, the unit operates in CW mode, and when it is low, the unit operates in Pulse mode. While the unit is operating, do not change this signal. It may cause a FAULT condition.

1.4.3 POWER signal (INPUT) for all models

Analog signal to control laser head current both in CW and Pulse mode. Even in Pulse mode, the POWER signal will control an average H.V.. pulse current.

1.4.4 RESET signal(INPUT) for all models except CPZ-series

To reset an activated protection circuit and to recover from the fault condition, this signal must be on and then off. The unit starts to restore not at the rising edge of RESET signal(ON edge) but the falling edge(OFF edge). If the fault is caused by a temporary reason (that is, the fault reason is already removed

before sending RESET), the unit will be restored to a previous operating condition **as soon as RESET signal comes to the OFF edge.**

During normal operating time, there is nothing happen (not harmful) to push this Reset SW.
If the fault condition exists, the unit may operate for a short time (until protection circuits detect the fault condition) and then becomes fault again. If the unit keeps this cycle, do not try resetting anymore. There must be something wrong. Refer to 4.4 TROUBLE SHOOTING

CAUTION:
Power supply will produce sudden high voltage as soon as RESET SW is released.

1.4.5 SIMMER signal (INPUT) as Options

Analog signal to control simmer current both in CW and Pulse mode. As soon as this signal is input, the unit will generate an H.V. output controlled by SIMMER level.

CAUTION:
Even if the LASER is off, H.V. current will flow in this mode unless SIMMER signal is zero.
Be aware that the unit will create sudden H.V. when AC power is applied.

1.4.6 READY signal (OUTPUT) for all models except CPZ-series

Indicates that the power supply is ready to use. When internal main voltage is settled, this signal comes to high.

1.4.7 FAULT signal (OUTPUT) for all models except CPZ-series

Indicates that OVER CURRENT, OVER VOLTAGE or OVER TEMPERATURE protection circuits inside the unit are activated.
When the protection circuits detect a fault condition, the unit stops operation instantaneously, sending this signal to external.

1.4.8 HV1 signal (OUTPUT) as Options

Readout output signal to monitor the laser head current. This signal is proportional to a real laser head current, but the value is not normalized.

1.4.9 HV2 and HV3 signal (OUTPUT) as Options

Output signals to monitor the laser head voltages. These voltages are proportional to a real laser head voltage, the values are not normalized.

1.5. CSF-25000/8 Signals

CSF-25000/8 has many control signals as follow. The following table summarizes each signal meaning. If user has questions about this signal, please contact to factory.

1	REST	Input signal to reset FAULT condition
2	+5V	DC power for the internal circuit of power supply
3	GND	+5V DC ground
4	LASR	Input signal enables power supply either ON or OFF
5	RAMP	Input signal to activate RAMP signal
6	HVON	Output signal indicates H.V output voltage existing
7	HVCR	Analog output signal corresponding to total H.V current
8	HVLT	Analog output signal corresponding to H.V output voltage
9	TEMP	Output signal indicating over temperature failure
10	SWOC	Output signal indicating over current failure in primary circuit(#1)
11	CWPL	Input signal to activate CW or PULSE mode
12	HVOV	Output signal indicating H.V over voltage failure
13	HVOC	Output signal indicating H.V over current failure
14	REDY	Output signal indicates power supply is ready for H.V output
15	POWR	Analog input to control H.V current
16	FULT	Output signal indicates power supply is in fault condition
17	DEST	Output signal indicating over current failure in primary circuit (#2)
18	GDD	Power GND for external circuit
19	SIMR	Input signal to activate simmer mode
20	SIGG	Analog GND
21	VDD	DC power for external circuit
22	PWFL	Output signal indicating phase failure
23	WVFM	Analog signal showing SW current
24	LEAK	Output signal indicating over H.V leakage current
25	ENBL	Input signal enables power supply ON state

1.5 INTERFACE

1.5.0 Interface Card & Signals

Refer to also:
http://www.licengine.com/support/interface.html

1.5.1 +5VDC

+5V DC power source is included in all the units except CPZ-series**.** **Do not use this +5V DC power for an external circuit.** There is not enough capacity to drain and if 5V DC is disturbed by an external circuit, the power supply cannot maintain a stable operation.

1.5.2 Output & Input Signal Condition

CPZ-series:

1-1). POWER (Input)
10K ohm impedance
1-2). LASER (Input)
1K ohm impedance
1-3). S.P (Input)
4.7K ohm impedance

CPF- ,CNF-, CPP-, & CSF-series:

2-1). POWER (Input)
10K ohm impedance
2-2). SIMMER (Input)
Infinity impedance.
2-3). LASER, RESET (Input)
4.7K ohm impedance
2-4). FAULT, READY (Output)
4.7K ohm pull up resistor
2-5). H.V.1-H.V.3 (Output)
100 ohm impedance

1.5.3. Pin assignment.

CPZ-Series / D-SUB, 9 PIN:

1: NC
2: +5V DC
3: GND

4: LASER
5: S.P
6: NC
7: POWER
8: NC
9: NC

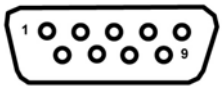
CSF-Series / D-SUB 9 & 15 PIN:

Pin Assignment:
Connector: D-sub 9P & 15P male

9P	15P		
1	1	RESET	Input signal to recover from a fault condition.
2	2	+5	DC power used inside circuit of power supply.
3	3	GND	DC power ground
4	4	LASER	Drive signal enables power supply to be either ON or OFF. In Pulse mode, a modulated pulse train will be inputted.
5	5	CW/PULSE	Input signal to activate CW or PULSE mode.
6	9	READY	Output signal indicate that power supply is ready for use.
7	10	POWER	Analog signal to control output current
8	11	FAULT	Output signal indicates that protection circuit inside power supply is activated.
9	12	SIMMER	Input signal to activate simmer mode.
Option:			
	6	H.V. 1	Analog signal proportional to H.V current.
	7	H.V. 2	Analog signal proportional to H.V voltage1.
	8	H.V. 3	Analog signal proportional to H.V voltage2.

CPF- ,CNF-, CPP-, & CSF-series / D-Sub 9P:

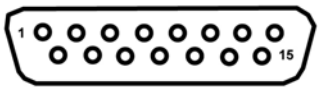
1: RESET
2: +5V DC
3: GND
4: LASER
5: CW/PULSE
6: READY
7: POWER
8: FAULT
9: SIMMER



D-Sub, 9P Male
(Top View)

CPF- ,CNF-, CPP-, & CSF-series / D-Sub 15P:

1: RESET	9: READY
2: +5V DC	10: POWER1
3: GND	11: FAULT
4: LASER	12: SIMMER
5: CW/PULSE	13: AGND
6: H.V. 1	14: NC
7: H.V. 2	15: NC
8: H.V. 3	



D-Sub, 15P Male
(Top View)

CSF-2500PD & CSF-25000/8:

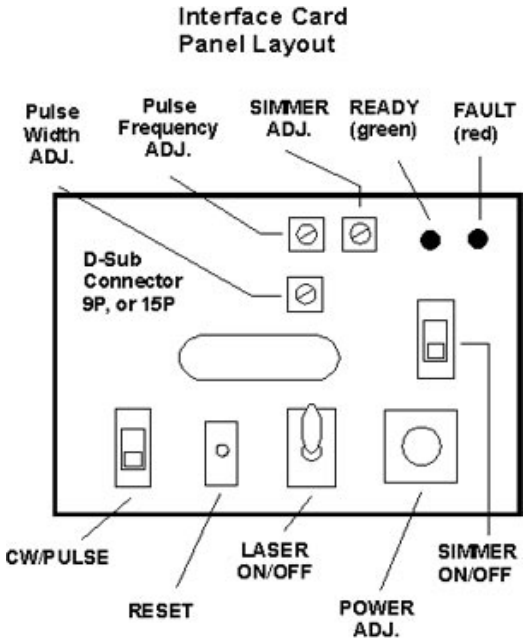
Pin Assignment:

Connector: D-sub 25P male

1	REST	Input signal to reset FAULT condition
2	+5V	DC power for the internal circuit of power supply
3	GND	+5V DC ground
4	LASR	Input signal enables power supply either ON or OFF
5	RAMP	Input signal to activate RAMP signal
6	HVON	Output signal indicates H.V output voltage existing
7	HVCR	Analog output signal corresponding to total H.V current
8	HVLT	Analog output signal corresponding to H.V output voltage
9	TEMP	Output signal indicating over temperature failure
10	SWOC	Output signal indicating over current failure in primary circuit(#1)
11	CWPL	Input signal to activate CW or PULSE mode
12	HVOV	Output signal indicating H.V over voltage failure
13	HVOC	Output signal indicating H.V over current failure
14	REDY	Output signal indicates power supply is ready for H.V output
15	POWR	Analog input to control H.V current
16	FULT	Output signal indicates power supply is in fault condition
17	DEST	Output signal indicating over current failure in primary circuit (#2)
18	GDD	Power GND for external circuit
19	SIMR	Input signal to activate simmer mode
20	SIGG	Analog GND
21	VDD	DC power for external circuit
22	PWFL	Output signal indicating phase failure
23	WVFM	Analog signal showing SW current
24	LEAK	Output signal indicating over H.V leakage current
25	ENBL	Input signal enables power supply ON state

1.5.4. Control Card for:

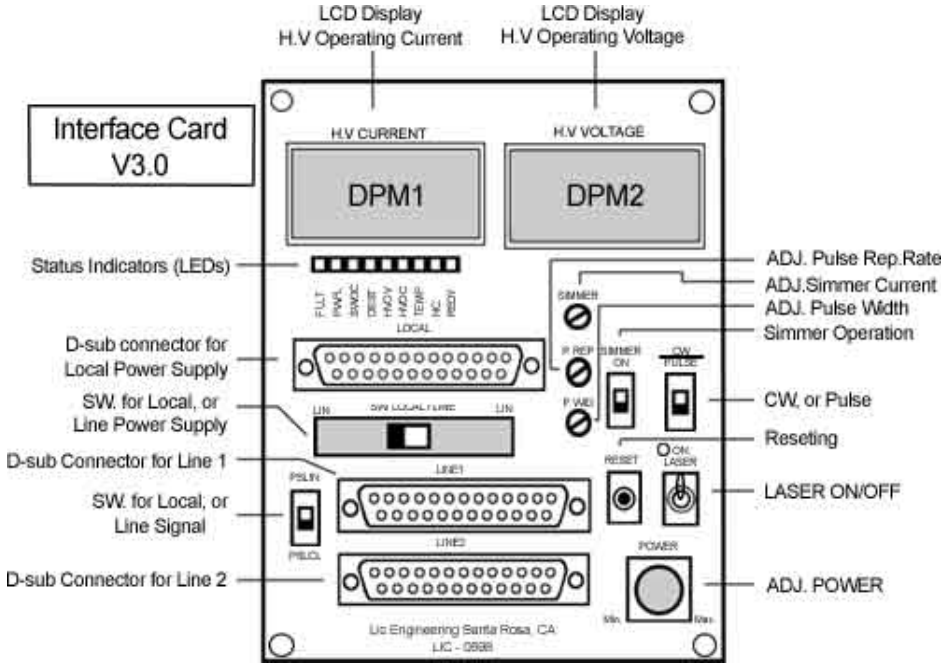
■ **CPF- ,CNF-, CPP-, & CSF-series:**



(Fig -2)

■ **CSF-2500PD & CSF-25000/8:**

(picture-1)
CSF-25000/8 Control Card



(Fig-3)

Control Card for CSF-2500PD & CSF-25000/8 uses D-Sub 25P male connecter to interface the units.
This card has many features:

1). Displays H.V Current & Voltage with real time.
2). All signals are optically isolated from the unit.
3). Daisy chain connection is possible so that user can operate several units with one control card.
4). Line and Local switch/connecter can switch between Local that can control only each unit and Line that control all power supply connected with daisy chain,
2). Displays all status signals as follows:

HVON	Output signal indicates H.V output voltage existing
HVCR	Analog output signal corresponding to total H.V current
HVLT	Analog output signal corresponding to H.V output voltage
TEMP	Output signal indicating over temperature failure
SWOC	Output signal indicating over current failure in primary circuit(#1)
HVOV	Output signal indicating H.V over voltage failure
HVOC	Output signal indicating H.V over current failure
REDY	Output signal indicates power supply is ready for H.V output
FULT	Output signal indicates power supply is in fault condition
DEST	Output signal indicating over current failure in primary circuit (#2)
HVOV	Output signal indicating H.V over voltage failure
HVOC	Output signal indicating H.V over current failure
REDY	Output signal indicates power supply is ready for H.V output
POWR	Analog input to control H.V current
FULT	Output signal indicates power supply is in fault condition
DEST	Output signal indicating over current failure in primary circuit (#2)

(Output status displays table)

2.0 INSTALLATION

2.1 GENERAL

After unpacking, general inspection and preliminary check-out procedures should be performed to ensure that the unit is in proper working order. If it is determined that the unit has been damaged, the carrier should be notified immediately. Contact Lic directly:

Lic engineering
3735 Coffey Ln.
Santa Rosa, CA 95403 USA
Tel: (707) 575 8821
Fax: (707) 526 3905
Email:tech@licengine.com

2.2 INSPECTION

Check for damage incurred during shipment as follows:
1) Inspect unit case for cracking, bending, and other obvious signs of damage.
2) Check water inlet & outlet for bending.

2.3 OIL FILLING (for 25KW/50KW OEM products only)

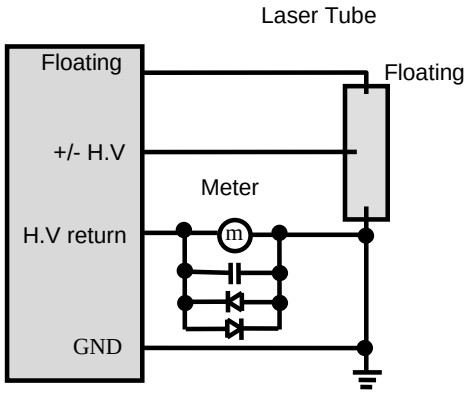
Loosen all screws on the top cover of H.V. container(oil container). Pull up whole body of the power supply from the H.V. container with care (not to damage oil seal). Pour the insulating oil supplied with a separated oil can into the H.V. container up to the line marked. When the oil level reaches the marked line, slowly put the whole power supply back to the H.V. container. Be careful that no H.V. components touch the open edge of H.V. container. Tighten all the screws for the top cover of H.V. container.

2.4 OUTPUT WIRE CONNECTIONS

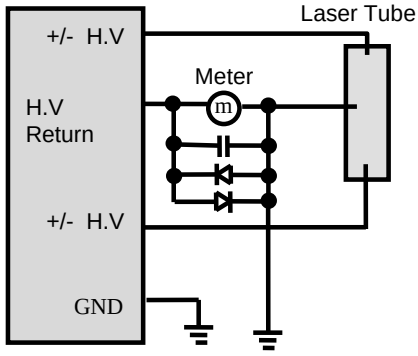
Refer to the following wiring diagram of Fig-4.

CAUTION:
Do not put a resistor in a H.V return line. H.V return line potential must be less than 1 V reference to GND in order for the error amplifier inside the unit to work properly

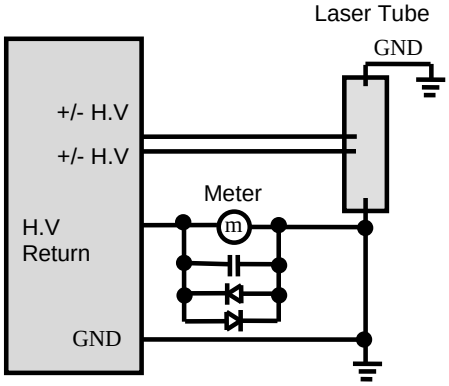
(1). Center +/- High Voltage, One GND, One Floating



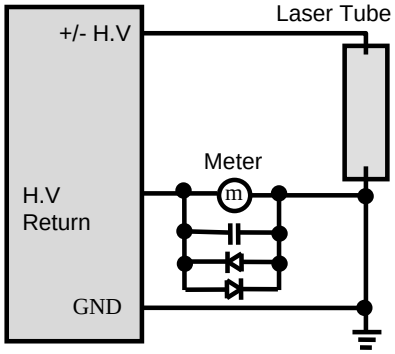
(2). Center GND, Both end High Voltage



(3). Dual High Voltage One GND



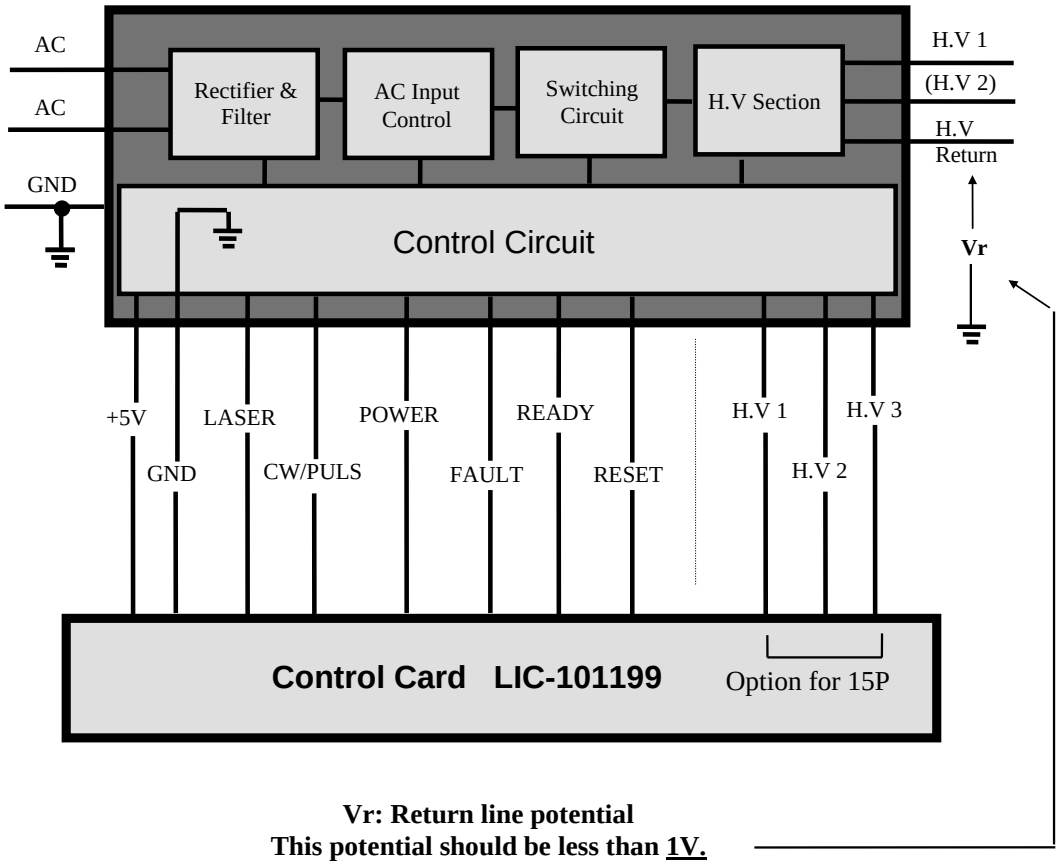
(4). Single Discharge, One High Voltage, One GND



Output Configuration Wiring (FIG-4)

2.5 CONTROL SIGNAL CONNECTION

2.5.1 CPZ - /CPF – CNF- /CPP- /CSF - Series



Vr: Return line potential
This potential should be less than <u>1V.</u>

Control Signal Connection
(FIG-5)

2.6 WATER LINE CONNECTION

Any tap water can be used. Connect cooling water lines to the power supply firmly. After connecting the line, apply the water pressure that is expected in that line. Confirm that the water temperature is within the specification for the unit and if there is no water leakage at the connections. Lic's power supply does not require much water to flow. Cooling water electrical potential is at the ground level.

Water Connection: ¼”NPT inlet/outlet (apply for CPF-600P/PD/WOM, CSF-2000/3400/8000) and 3/8” NPT inlet/outlet (apply for CSF-25000PD/8)

2.7 AC LINE CONNECTION

Confirm AC GND(Earth GND) is connected to the power supply GND. Confirm that AC line voltage is proper for the unit ordered, and AC power to the unit is still off. The standard center voltages are:

100/115/208/220/240/360/380/440/480V, Single/Three phase, +/- 10%

3.0 OPERATION

3.1 PREPARATION

3.1.0 PRECAUTION

1). Shut off the unit
Do not shut off AC line voltage while the power supply is running. This is not good manner to stop the power supply.

2). Capacitor bank
Once AC voltage is applied to the power supply, there is stored energy in a capacitor bank of primary circuit. This energy is discharged through a resistor, but it may take 1-5 minutes. This does not do anything for user but just remember it.

3). Remaining H.V
Once H.V is produced, there is a stored H.V in capacitors that may be in the H.V multiplier of the unit, or stray capacitance in H.V line and user's laser tube. Make sure the following:
A. Power supply or H.V switch is at off condition/ position.
B. Discharge the exposed H.V parts by a wire where user is going to touch.

3.1.2 LOAD CONDITION

Each unit is adjusted at Lic's factory to match each customer's specified laser head impedance. This should be verified before connecting the power supply to the laser head.

3.2 STARTING IN CW MODE

3.2.1 WITHOUT SIMMER

STEP 1. CONTROL UNIT ON

Customer's control unit power on. Switch LASER signal off, SIMMER off, CW/Pulse signal to CW, and POWER signal to zero.

STEP 2. AC POWER ON

Turn AC power of the power supply on. Confirm READY will come on in 10-30 seconds.

STEP 3. STARTINGH.V.

Turn LASER on. Watching H.V. current, gradually increase POWER signal. With dummy load, the H.V. current should be controlled smoothly from zero to its maximum. When an actual laser head is

connected, however, the H.V. current will generally be unstable at low current.

Note:
If H.V. current does not start to flow in spite of certain level of POWER signal, or FAULT comes, or there are unusual sounds or odors detected, take AC line off immediately from the unit.
Refer to TROUBLE SHOOTING in SECTION 4.4.
If it seems difficult to locate the problem, contact Lic directly:

3.2.2 WITH SIMMER

CAUTION:
Even LASER is off, H.V. current will flow in this mode unless SIMMER signal is zero. Be aware that the unit will create sudden H.V when AC power is applied under this mode.

STEP 1. CONTROL UNIT ON

Customer's control unit power on. Turn LASER signal off, switch CW/Pulse signal to CW, SIMMER SW to off, and POWER & SIMMER levels to zero.

STEP 2. AC POWER ON

Turn AC power of the power supply on.
Confirm READY will come on in 10-30 seconds.

STEP 3. STARTING SIMMER

Turn SIMMER SW on. Watching H.V. current, gradually increase SIMMER level.
With dummy load, the H.V. current should be controlled smoothly from zero to its maximum.
When an actual laser head is connected, however, the H.V. current will generally be unstable at low current.

STEP 4. STARTING MAIN DISCHARGE

Turn LASER on. Watching H.V. current, gradually increase POWER signal.

3.3 STARTING THE UNIT IN PULSE MODE

Note:
Prior to starting Super Pulse, make sure that the unit operates without problems in CW mode.
The power supply may produce certain sounds in Super Pulse mode. This is because a repetition rate of input pulse is in an audible frequency range and high voltage components in the power supply are mechanically vibrated by strong pulse currents. Such sounds are normal and not harmful to the unit.

Even in CW mode, the power supply may produce small sounds at very low current caused by a pulsing current(discontinued current).

3.3.1 WITHOUT SIMMER

STEP 1. CONTROL UNIT ON

Customer's control unit power on. Switch LASER signal off, SIMMER off, CW/Pulse signal to PULSE, and POWER signal to zero.

STEP 2. AC POWER ON

Turn AC power of the power supply on. Confirm READY will come on in 5-30 seconds.

STEP 3. STARTING H.V.

Turn LASER on. Watching H.V. current, gradually increase POWER signal. With dummy load, the H.V. current should be controlled smoothly from zero to its maximum. When an actual laser head is connected, however, the H.V. current will generally be unstable at low current.

3.3.2 WITH SIMMER

STEP 1. CONTROL UNIT ON

Power customer's control unit on. Turn LASER signal off, switch CW/Pulse signal to PULSE, SIMMER SW to off, and POWER & SIMMER level to zero.

STEP 2. AC POWER ON

Turn AC power of the power supply on. Confirm READY will come in 5-30 seconds.

STEP 3. STARTING SIMMER

Turn SIMMER SW on. Watching H.V. current, gradually increase SIMMER level. With dummy load, the H.V. current should be controlled smoothly from zero to its maximum. Set the desired simmer level.

STEP 4. STARTING MAIN DISCHARGE

Turn LASER on. Watching H.V. current, gradually increase POWER signal.

3.4 **TURN THE UNIT OFF**

STEP 1. LASER off
STEP 2. SIMMER off (if applicable)
STEP 2. Turn AC line off

4.0 MAINTENANCE

4.1 GENERAL

Lic's CO_2 laser power supply contains potentiometers that are set at Lic's factory. Do not try to adjust these potentiometers. **There are no user-serviceable parts in Lic's products.**
IF USER ATTEMPTS TO OPEN, ADJUST, MODIFY, OR REPAIR THE PRODUCTS, THEN LIC ENGINEERING CAN NO LONGER BE RESPONSIBLE FOR THE SAFE OPERATION OF THE UNIT, AND THE WARRANTY SHALL BE IMMEDIATELY VOID.

4.2 PERIODIC SERVICING

OIL FILLING AND CHANGE (for CSF-25000PD and CSF-25000/8 OEM unit only)
Periodically check oil color and oil level of H.V. container. If the oil color becomes dark brown, it is the time to replace the oil. If the oil level is too far below the line on the container, add oil. In both case, follow the steps described in the Installation section.
Oil type: Shell Diala AX

4.3 CAUTION

1). DO NOT ALLOW THE UNIT TO BE IN OPEN CIRCUIT.
2). DO NOT ALLOW THE UNIT TO BE SHORT CIRCUIT.
3). DO NOT ATTEMPT TO OPEN, MODIFY OR ADJUST ANY PARTS OF THE POWER SUPPLY.
4). DO NOT MECHANICALLY SHOCK.
5). KEEP WATER OR MOISTURE FROM THE UNIT EXCEPT IN-/-OUTLET OF THE UNIT.
6). DO NOT MISUSE, OVERUSE, OR ABUSE THE UNIT.

4.4 TROUBLE SHOOTING

4.4.1 NOT READY SIGNAL COMES ON

CAUTION:
IF READY DOES NOT ON APPEAR WITHIN 60 SECONDS AFTER TURNING ON AC POWER OF THE UNIT, SWITCH AC POWER OFF IMMEDIATELY TO AVOID DESTROYING INTERNAL COMPONENTS.

1). Confirm that LASER and POWER signals stay at ground level.
2). Check all signal conditions including DC power line.

4.4.2 FAULT COMES ON

1). Check head impedance.
Check laser head impedance. If the impedance is too low, the power supply may be tripped by the over current protection circuit.

If the laser head impedance is too high, the over voltage protection may be activated.
If customer uses a gas flow type laser, check the gas pressure and gas flow rate of the laser system.

2). Check cooling water flow rate and temperature.
If water flow rate is too low, or the temperature is over 25C, the power supply may be tripped by an over temperature protection.

3). Check high voltage, floating and its return lines if there is no open circuit.
Check if there are no unusual sounds detected at start up time.

4.4.3 OUTPUT DOES NOT APPEAR

1). Confirm READY is active, LASER is on, and POWER signal has certain voltage levels.

2). Check AC power and all control signals condition.

4.4.4 ODORS OR UNUSUAL SOUNDS

If odors or unusual sounds are detected, turn LASER off, and take AC power off immediately. Contact Lic.

Note:
The power supply may produce certain sounds in Pulse mode. This is because a repetition rate of input pulse is in an audible frequency range and high voltage components in the power supply are mechanically vibrated by strong pulse currents. Such sounds are normal and not harmful to the unit. Even in CW mode, the power supply may produce small sounds at very low current caused by a pulsing current (discontinued current).

5.0 WARRANTY

5.1 WARRANTY

Lic engineering warrants its products against all defects in materials and workmanship to the original using purchaser for a period of one year from the date of delivery to the original purchaser.
During this period, Lic engineering will repair or replace its products if defective free of charge. This warranty applies only when the products are properly installed, maintained and used for the intended purpose, and only to the original purchase/user of the products, and only so long as the products are used in the country to which it was originally shipped by Lic engineering, or by an authorized distributor.
Any shipping charge incurred shall be paid by the purchaser/user of the products.

This warranty is null and void if the user attempts to service the products (other than performing the maintenance described in the Instruction Manual), or if service is performed by people who are not trained and authorized to do so by Lic engineering.

THE EXPRESS WARRANTY ABOVE IS THE SOLE WARRANTY OBLIGATION OF LIC ENGINEERING AND THE REMEDY PROVIDED ABOVE IS IN LIEU OF GUARANTEES, OR WARRANTIES--ORAL OR WRITTEN, EXPRESS OR IMPLIED-- INCLUDING WITHOUT LIMITATION WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.
LIC ENGINEERING HAS NO LIABILITY WHATSOEVER FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGE ARISING OUT OF ANY DEFECT, IMPROPER USE, OR UNAUTHORIZED SERVICE OR REPAIR.

5.2 RETURN OF THE UNITS

Prior to return of a unit, or any portion thereof, Lic must be consulted to avoid unnecessary shipping.
If return of the units are deemed necessary, a Return Authorization Number "RAN" will be assigned. This number must be recorded on the outside of the shipping container.

Contact:

Lic engineering
3735 Coffey Lane
Santa Rosa, CA, USA
Tel: (707) 575 8821
Fax: (707) 526 3905
email: info@LicEngine.com