REVISIONS

DCN	LTR	DESCRIPTION	DATE	CHANGED	CHECKED	APPROVED
	1	Preliminary	7/10/24	JTR		
	2	Added more verbiage on detailed operation of driver	8/21/24	JTR		
	3	Change document formatting, general update	2/5/25	JTR		
7706	A	RELEASED FOR PRODUCTION	250306	SWR		

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TOLERANCES

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.XX = N/A
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TITLE

OPERATING MANUAL, Model 788 Dual Channel Diode Driver

ANGULA R X = N/A	SCALE	SIZE	FSCM	SHEET	DRAWING NUMBER	REV.
	N / A	A	61651	1 OF 14	**21-035**	**A**

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CAUTION

- Read this manual carefully before attempting to install or operate the model 788.
- This unit contains no user serviceable parts. Manufacturer's warranty is void if field serviced.
- Proper installation is necessary to limit access to lethal voltages. This driver has capacitor voltages up to 90VDC and energies of 50J. Do not attempt to access unit until the input power is removed and the red LED has extinguished.
- It is the user's responsibility to use this product in a safe manner.

High Voltage Present. This equipment produces high voltages which can be fatal. Only qualified service personnel are permitted to install this power supply.

1 INTRODUCTION

The 788 is a dual channel laser diode driver consisting of two separate channels of equal current up to 17.5 Amps, or a single channel up to 35 Amps. Input voltage is 48VDC and output compliance is up to 75V with some trade-offs at the extremes. A boost converter charges a capacitor bank up to 89 volts, and then two buck converters generate programmed currents into the load(s). A master measures the actual output current, and a slave is set to the same peak and trough current levels to give the same average current.

2 ENVIRONMENTAL DATA

2.1 Operating

Ambient Temperature:	0 °C to +50 °C

2.2 Non-operating (transport and storage)

Ambient Temperature:	-20 °C to +70 °C
Relative Humidity:	0% to 95%, non-condensing
Altitude:	0 to 2000 m

2.3 Environmental Risk

The substances used in the product pose no known health or environmental risk associated with the disposal of the product at the end of their useful lives.

2.4 Regulatory

RoHS	DIRECTIVE EU 2015/863 (RoHS 3)
MTBF	> 10,000 hours

3 SET-UP AND INTERFACE

3.1 Mechanical Considerations

Installation begins with mounting the module in a suitable enclosure. Follow the criteria below:

3.1.1 Enclosure must provide protection against possible human contact with live parts.

3.1.2 Enclosure must be adequately grounded to protective earth to ensure operator safety or constructed entirely of a non-conductive material. In the latter case, all internal exposed metal parts must be grounded to protective earth. The attached heat sink is electrically connected to the return of the 48V and circuit common ground, so generally will not be connected to the exterior case at that point.

3.1.3 A clearance of at least 1 inch should be maintained on the air input and output sides to facilitate proper air flow, or as determined to facilitate optimum plate cooling.

3.1.4 Typical mounting uses (2) plastic slide rail guides, one on each side of the unit. There are no components, traces, or holes within 3mm of the side edges of the PCB. At the top of the mounted assembly, there is one M3 hole (in the heatsink) to help hold the unit in place. See Outline drawing.

3.2 Electrical Connections

Electrical connections are made in two groups: the input power/controls group and the laser diode output group. These groups are terminated in two different connectors.

3.2.1 Input Power/Controls Group

The 48VDC input power enters the unit through connector P1. The unit connector is a Harting 09231486921 48 pin, three row connector. Input current is dependent on the output power. To determine required input current, use the following formula.

$Iin \cong \frac{Po}{eff * Vin\_min}$, where efficiency is ~89% and Vin min is 46V

All control signals are together with the power inputs on P1. A description of each is listed in Table 1.

3.2.2 Laser Diode Output Group

The two Laser Diode output connectors are terminal blocks J1 (master) and J2 (slave). The two terminal blocks are Phoenix Contact 1017503.

The laser diode anodes are on pin 1 and cathodes on pin 2.

**** The laser diode must be floating. Neither side of the laser diode can be connected to ground/chassis.****

The following connections are available from connector P1:

Table 1, Power/Control Interface Signals

Pin No.	Name	Function	Notes
A1	SIGNAL GROUND	Signal Ground	Connected to 48V return or negative. Use for logic returns.
A2	SIGNAL GROUND	Signal Ground	Connected to 48V return or negative. Use for logic returns.
A3	BUCK SLAVE INHIBIT	Inhibits buck slave converter	2.5 to 12V for inhibit. 22K load.
A4	SIGNAL GROUND	Signal Ground	Connected to 48V return or negative. Use for logic returns.
A5	CURRENT DEMAND -	Return for output current demand	Analog input to differential amplifier. >10K impedance.
A6	OP SHORT OFF	High un-shorts laser diodes	12K impedance. 2 to 8V un-shorts master and slave loads. Hold high for repetition rate operation. Can be shorted >100uS after burst.
A7	BANK VOLTAGE ADJUST	Adjusts bank voltage incrementally.	No effect open circuit or at 2.23V. Analog signal scaled 7.2V per delta bank volts. 60k impedance. Higher bank voltage not recommended. R to ground OK.
A8	BANK READY	Outputs logic high when bank >54V	5V via 1K for high (Ready).
A9	BOOST POWER	0 to 2.5V sets boost converter power	Analog input. 2.13K impedance. The boost converter powers both buck driver stages. 0 to 2.5V sets boost power 0 to 575W.
A10	SIGNAL GROUND	Signal Ground	Connected to 48V return or negative. Use for logic returns.
A11	48V+ INPUT	From +48 V power source	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
A12	48V+ INPUT	From +48 V power source	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
A13	48V+ INPUT	From +48 V power source.	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
A14	48V_RETURN/GROUND	48V return or negative	Connected to signal ground internally at CEP. Supply should be floating on this ground. CEP=Central Earth Point
A15	48V_RETURN/GROUND	48V return or negative.	Connected to signal ground internally at CEP. Supply should be floating on this ground.
A16	48V_RETURN/GROUND	48V return or negative	Connected to signal ground internally at CEP. Supply should be floating on this ground.
B1	TEMPERATURE STATUS	Logic signal, High = good	Goes low and inhibits operation if PCB exceeds 85C. 12K output impedance to +5V for high; 2K to ground for low (too hot),
B2	JUMPER 1	Link	Linked to B3 on PCB. Floating.

B3	JUMPER 2	Link	Linked to B2 on PCB. Floating.
B4	MASTER CURRENT	Analog master current sense output from current source	2K internal load in parallel with 470pf capacitor. Scale factor into a high impedance 2.5V ~ 17.5A
B5	CURRENT DEMAND +	Output current demand	Differential input used with A5. Scale Factor 2.5V ~ 17.5A.
B6	SLAVE CURRENT	Analog slave current sense output from current source	2K internal load in parallel with 470pf capacitor. Scale factor into a high impedance 2.5V ~ 17.5A
B7	BANK_VOLTAGE	A scaled voltage representing the Bank Voltage	Output of 1K impedance scaled at 2.5% of the Bank Voltage. 90V = 2.245V
B8	SPARE	Not used.	
B9	BOOST IS ENABLED	Logic high output when BOOST ENABLE is high	Output. 2K impedance. Logic level is similar to BOOST_ENABLE level.
B10	5V AUX	Plus 5V	Auxiliary supply generated from +48V input. Up to 100ma is available for external use when +48V is present.
B11	48V+ INPUT	From +48 V power source	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
B12	48V+ INPUT	From +48 V power source	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
B13	48V+ INPUT	From +48 V power source	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
B14	48V_RETURN/GROUND	48V return or negative	Connected to signal ground internally at CEP. Supply should be floating on this ground.
B15	48V_RETURN/GROUND	48V return or negative	Connected to signal ground internally at CEP
B16	48V_RETURN/GROUND	48V return or negative	Connected to signal ground internally at CEP
C1	TEMPERATURE	Analog output of board temperature status	1k series resistor, T= (1.8015-Vout/0.010062) + 30 degrees C. 30C= 1.50V. 85C =1.248V. Hard shutdown at 85C with 10 degrees hysteresis.
C2	BUCK SLAVE IS ENABLED	Logic high when true	4V via 1K when buck slave is enabled. Ground via 11K when disabled.
C3	EMISSION STATUS	Logic high when >1 amps is flowing in either output	4.5V low impedance when either Master or Slave is above 1 amp. 10K to ground when both <1 A.
C4	BUCK MASTER IS ENABLED	Logic high when true.	4V via 1K when buck master is enabled. Ground via 11K when disabled.
C5	BUCK ENABLE	Logic high input to enable BUCK	4 to 5 V desired into 8K load. 2uS noise filter. Enables buck stages.
C6	SIGNAL GROUND	Signal Ground	Connected to 48V return or negative. Use for logic returns.

C7	BANK CHARGED	Logic high output when bank >94% of maximum value.	1K output impedance to +5V or 0V. +5V = charged.
C8	BANK DISCHARGED	High output when the Bank is <2% of maximum (discharged).	1K output impedance to +5V or 0V. +5V = discharged.
C9	BOOST ENABLE	Logic high input to enable BOOST	Load 2K+. Must be able to sink 2ma to ground to ensure buck is also disabled when BOOST ENABLE is low. Enables +48V and disables dump. High input is 3V - 5V.
C10	48V OOT	48V out of tolerance, too high or low.	4.5V low impedance when true. 10K to ground when no current. High when 48V is not between 46 and 50V. Shuts down 48V, bucks and boost.
C11	SPARE	Not used.	
C12	48V+ INPUT	From +48 V power source	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
C13	48V+ INPUT	From +48 V power source	Up to 14 amps current. Tolerance +/- 2V. Soft start circuit.
C14	SPARE	Not used.	
C15	48V_RETURN/GROUND	48V return or negative	Connected to signal ground internally at CEP. Supply should be floating on this ground.
C16	48V_RETURN/GROUND	48V return or negative.	Connected to signal ground internally at CEP. Supply should be floating on this ground.
J1			The 2-pin output connector is Phoenix Contact 1017503
1	ANODE_MASTER		At bank voltage potential, less some mV for current sensing resistor.
2	CATHODE_MASTER		Up to bank voltage potential. When working, less laser diode drop.
J2			The 2-pin output connector is Phoenix Contact 1017503
1	ANODE_SLAVE		At bank voltage potential, less some mV for current sensing resistor.
2	CATHODE_SLAVE		Up to bank voltage potential. When working, less laser diode drop.
LED1	Visual LED on PCB	Illuminates when Bank voltage present.	Operates down to 3V on bank.

4 OPERATION

4.1 Power Up Sequence

Care must be exercised in the power up/down sequence.

Before applying 48VDC to the driver module,

- Set Boost Enable low.
- Set Current demand to 0V
- Set Buck Enable low

Apply 48VDC to the driver module,

- Set OP Short Off high. This removes the short from the outputs.
- Set Boost Power to desired boost converter power.
- Set Boost Enable high.
- For pulsed operation, simultaneously set Current Demand to desired value and set Buck Enable high. Simultaneously terminate both at desired pulse width.

4.2 Power Down Sequence

Before removing DC from the module,

- Set Buck Enable low
- Current demand should be set to 0V
- Set Boost Enable low.
- The DC power may then be removed.

4.3 Cooling

The driver module can operate without forced air under light load conditions. The module comes with a heatsink mounted to the power electronics. For higher power applications, flow a minimum of 250LFM across the heatsink and top side of PCB. A suitable clearance should be maintained on the air input and output sides to facilitate optimum air flow. Airflow direction is not critical.

An analog output on interface C1 gives the board temperature and a shutdown occurs at 85 degrees with an automatic reset at 75 degrees Celsius.

4.4 Setting Boost Power demand, and input 48V

The 788 incorporates a 10mF 48V input capacitor to minimize variations in demand on the 48V power supply as well as an LC filter to minimize conducted noise. We typically use the Meanwell range RSP-500-48 with power factor correction, or LRS-600-48 for budget applications. A soft start circuit is built in to the 788 to safely charge the 10mF capacitor.

There is a small offset in the boost demand to ensure that zero input is not used internally. The boost current is generally set at the lowest safe operating value to minimize the input current flicker. A good starting point is 2V and this may be adjusted up or down making sure that the maximum output demand conditions are met. The boost stage keeps the 3 storage capacitors charged to 89V although these may decay in voltage when using output joules exceeding the input current settings. This feature allows up to 50 joules output pulse energy to be achieved. Both stages draw energy from the boost storage capacitors. A small adjustment of the boost voltage may be made externally by drawing current to ground using A7. The bank voltage must not exceed 92V. Normally this pin is left open using the internal reference. The Bank is dumped when the unit is turned off. 10 seconds should elapse before restarting.

4.5 Output Current and Buck stages

The output currents may be doubled for the same input demand by connecting the outputs in parallel, anode to anode and cathode to cathode. A power FET is turned on across the output load for protection when not actively in use.

The default condition is shorted (ON) so A6 must be enabled, say, 100uS before using the module. Because of charge stored in the output filter across the load, do not turn the short FET ON (A6 low) with a voltage across the load.

The Demand input is differential over a volt or so to reduce noise errors by returning the negative input to the voltage source.

4.6 Safety features and interface simplification

The 788 has many safety features built in. In accordance with Table 1, the Master Current is monitored at B4; the Slave Current at B6; and the scaled Bank Voltage at B7. B9 indicated that the Boost is enabled, and B10 allows the +5V to be checked with up to 100ma available for external use assuming that the +48V is present. The 48V input and return power connections must be connected in parallel to share the load.

C2 gives a logic high when the Buck Slave is enabled, C4 indicates the Buck Master is enabled and C3 indicates that current is flowing in either of the outputs, indicating a possible light emission.
For safety, C7 gives a logic high when the storage capacitors are charged and C8 goes high when they are discharged. A visual LED illuminated on the PCB when voltage >3V is present on the Storage Bank.
If the 48V is out of tolerance a logic high is indicated on C10.
B2 and B3 are linked on the 788 PCB. This may be used as a sense that the board is connected.
Based on the above descriptions and Table 1, one may decide whether or not to use these functions depending on the criticality of the application.

Accessories
An interface cable is available (23-007-09). If the termination does not use the same connector, then the cable may be cut potentially to create 2 cables.
A test box with cable is available to allow the 788 to be powered up quickly for evaluation. Part Number 788-PCB.

5 MAINTENANCE

No maintenance is required except to keep the unit free of dust and FOD.
The various monitor outputs may be utilized as a self-check.

CAUTION

To prevent electric shock, do not remove screws. There are no user serviceable parts inside. Refer all servicing to factory qualified service personnel.

6 DOCUMENTATION

Figure 1, 788 Image

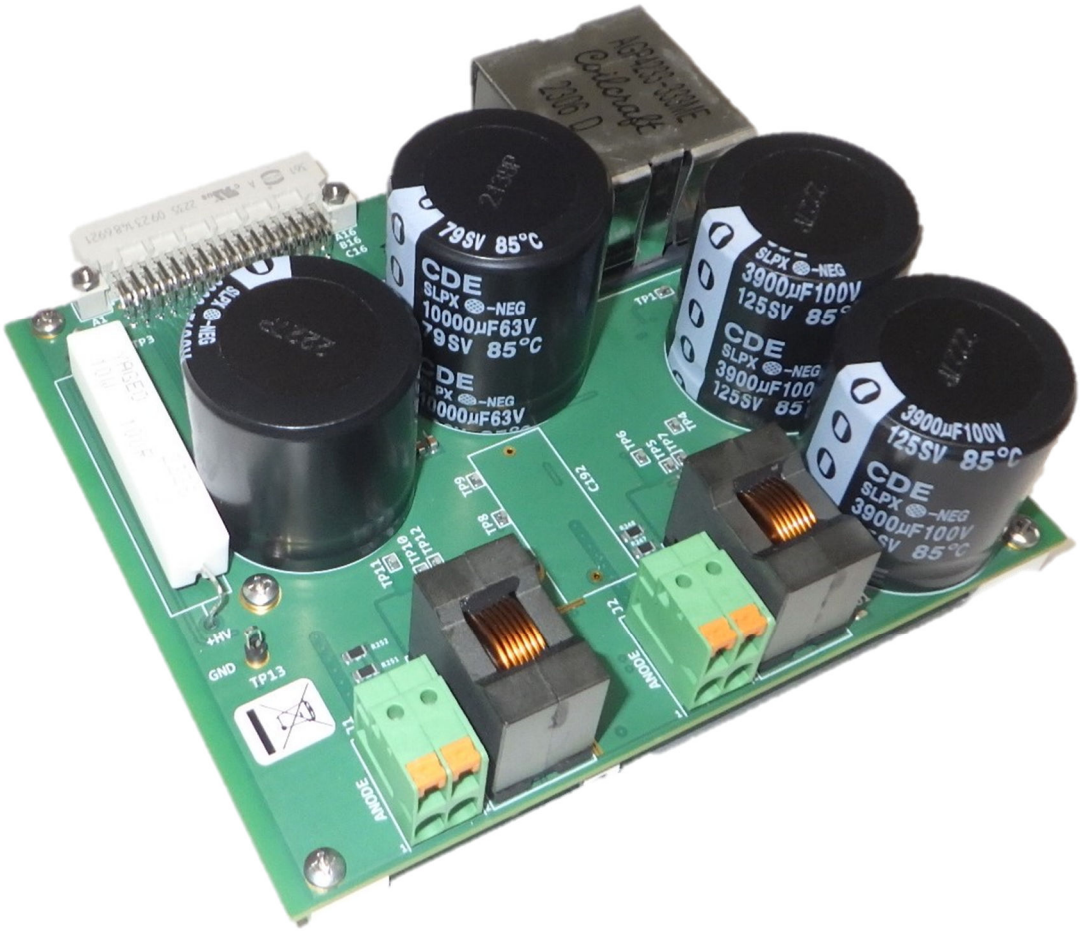

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Figure 2, Outline Drawing