LDI-800

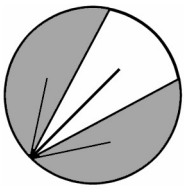
Laser Diode Driver

USER'S MANUAL

WARNING

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

The use of optical instruments with these products will increase eye hazard.



LASER
DRIVE
INC.

Last Revision: November 2000
Part Number: 636-00003-00 Rev 00

Warranty Policy

All LDI products are warranted to be free from defects in workmanship and materials ("Nonconformity") for a period of 1 Year from date of shipment. This warranty does not apply to products which LDI determines, upon inspection, have failed, become defective or unworkable due to abuse, mishandling, misuse, alteration, negligence, improper installation, use which is not in accordance with the information and precautions described in the applicable operating manual, or other causes beyond LDI's control. This warranty does not apply to (i) any products or components not manufactured by LDI or (ii) any aspect of the products based on Buyer's specification, unless Seller has reviewed and approved such specification in writing. EXCEPT FOR THE FOREGOING WARRANTY, LDI SPECIFICALLY DISCLAIMS AND EXCLUDES ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Buyer shall notify LDI of any Nonconformity during the warranty period, obtain a return authorization for the nonconforming products, and return the nonconforming products, freight prepaid, to LDI's designated facility along with a written statement describing the Nonconformity. LDI's sole and exclusive obligation under this warranty is to use reasonable commercial efforts, at LDI's option, to repair, replace or refund the purchase price for any products which are returned to LDI as set forth above and which are, after examination by LDI, determined in LDI's reasonable discretion to be nonconforming. In-warranty repaired or replacement products are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced products or components, however the warranty period does not include the time period between when LDI receives the nonconforming products and when LDI returns the repaired or replacement products to Buyer. Buyer agrees that the foregoing provisions constitute the sole and exclusive remedies available to Buyer for breach of warranty by LDI with respect to the products.

IN NO EVENT WILL LDI BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF ANTICIPATED PROFITS OR BENEFITS, EVEN IF LDI HAS BEEN INFORMED OF THE POSSIBILITY THEREOF IN ADVANCE. IN NO CASE WILL LDI'S AGGREGATE LIABILITY TO BUYER BE GREATER THAN THE PURCHASE PRICE PAID BY BUYER TO LDI FOR THE PRODUCTS WHICH ARE THE SUBJECT OF BUYER'S CLAIM.

The products are not authorized by LDI for Buyer's use in any device or application where the failure, malfunction or inaccuracy of the product carries a risk of death or serious bodily injury, such as, but not limited to medical equipment, nuclear facilities, aircraft operations, air traffic control, life support or other application representing a similar degree of hazard. Any such use is prohibited without prior written agreement of LDI under terms intended to allocate the risks of selling the product for such uses. Buyer will indemnify, defend and hold LDI harmless from all claims, losses, damages and expenses, including attorney's fees arising from any prohibited use or application of the products.

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Section 1

User Safety

1.1 Ground The Power Supply

To minimize shock hazard, the power supply must be connected to an electrical ground. The power supply is equipped with a three-conductor AC power cable which must be plugged into an approved three-contact electrical outlet.

1.2 Verify the Line Voltage Selector Setting

Before connecting the line cord, verify that the line voltage setting in the power module agrees with local line voltage. (See Section 6.4 and Figure 6.1)

1.3 Removing The Cover

WARNING:
DANGEROUS VOLTAGES EXIST INSIDE THE POWER SUPPLY, EVEN WITH THE POWER SWITCHED OFF. ONLY QUALIFIED SERVICE PERSONNEL SHOULD REMOVE THE COVER.

1.4 Servicing

There are no user replaceable parts inside the power supply. Refer all servicing to qualified personnel. (See Section 10.0)

1.5 FCC Compliance

THIS EQUIPMENT GENERATES, USES, AND CAN RADIATE RADIO FREQUENCY ENERGY AND IF NOT INSTALLED AND USED IN ACCORDANCE WITH THE INSTRUCTION MANUAL, MAY CAUSE INTERFERENCE TO RADIO COMMUNICATIONS. IT HAS BEEN TESTED AND FOUND TO COMPLY WITH THE LIMITS FOR A CLASS A COMPUTING DEVICE PERSUANT TO SUBPART J OF PART 15 OF FCC RULES, WHICH ARE DESIGNED TO PROVIDE REASONABLE PROTECTION AGAINST SUCH INTERFERENCE WHEN OPERATED IN A COMMERCIAL ENVIRONMENT. OPERATION OF THIS EQUIPMENT IN RESIDENTIAL AREAS IS LIKELY TO CAUSE INTERFERENCE, IN WHICH CASE, THE USER, AT HIS OWN EXPENSE, WILL BE REQUIRED TO TAKE WHATEVER MEAS-

URES MAY BE REQUIRED TO CORRECT THE INTERFERENCE.

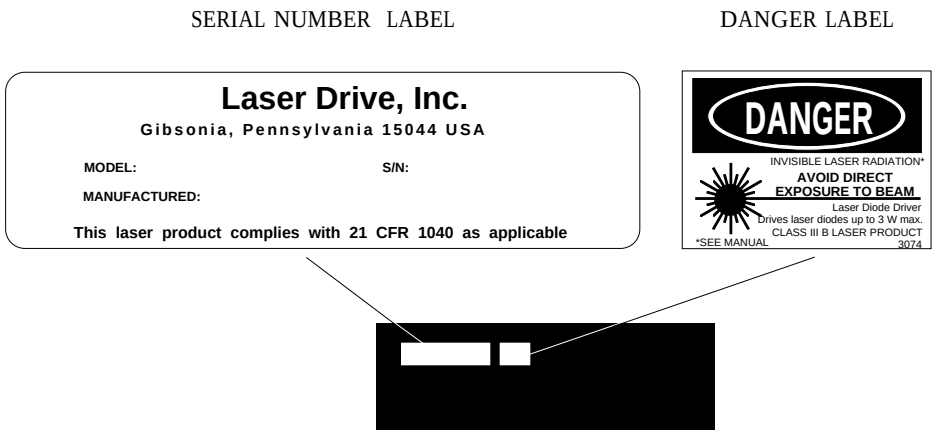
1.6 Laser Safety Warnings

The laser light emitted from laser diodes is invisible and may be harmful to the human eye. Avoid looking directly into the laser diode or into the collimated beam along its optical axis when the device is in operation.

Operating a laser diode outside of its maximum ratings may cause device failure or a safety hazard.

(See the laser's data sheet and technical notes)

Figure 1.1 CDRH Safety Labels



Section 2

Initial Inspection and Turn-On

2.1 Unpacking Your LDI-800

Upon receipt, carefully inspect the shipping container for damage. Carriers will not accept claims for damage unless all shipping materials are saved.

2.2 Setting the Line Voltage and Selecting a Fuse and Power Cord

See section 6.4 for a description of the power module. Verify that the line voltage selector and fuse are set properly. Verify that the line cord is correct for your location.

2.3 Initial Turn-On

READ THIS MANUAL BEFORE CONNECTING A LASER DIODE TO THE LDI-800

CAUTION:

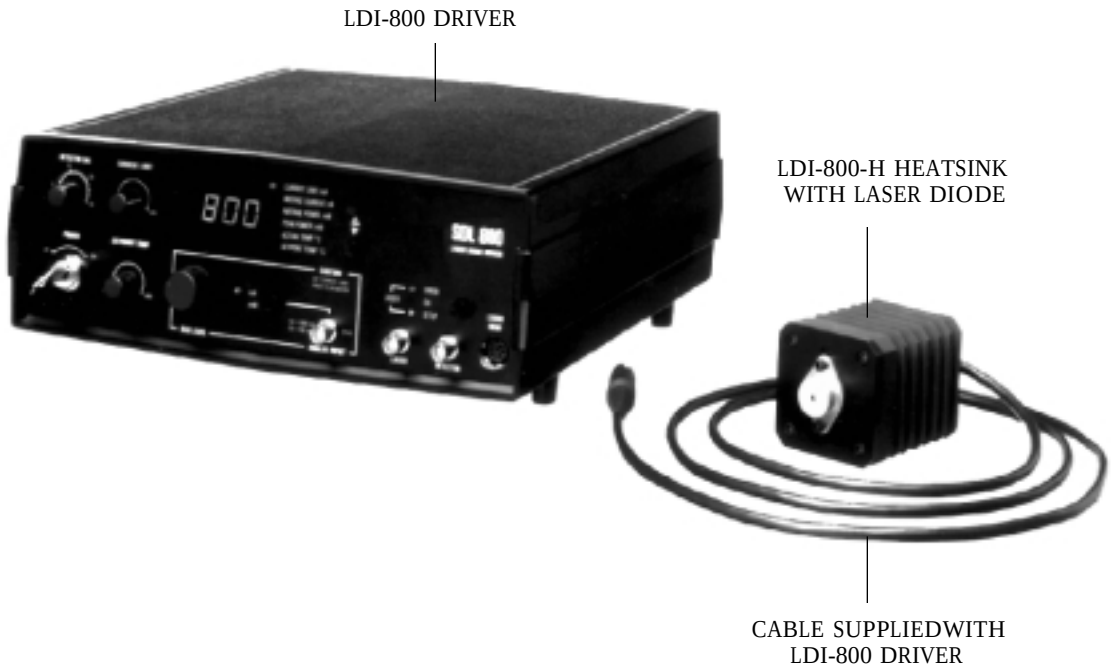
LASERS MAY BE DAMAGED BY IMPROPER SETTING OF THE CURRENT LIMIT AND BIAS CONTROLS OR BY IMPROPER USE OF THE ANALOG INPUT. SEE SECTIONS 5.3, 5.6, AND 5.8. CHECK THE LINE VOLTAGE SELECTOR AND FUSE BEFORE CONNECTING POWER.

The remote interlock plug must be installed in the rear panel. It is installed when shipped. If it is not in place, the LDI-800 ERROR light will remain on and the unit will be inoperable.

Use Section 9.1 to verify proper operation upon receipt.

Section 3

Product Description



The LDI-800 Laser Diode Driver may be used to power laser diodes requiring up to 1000 mA of drive. Current control or optical power monitor modes may be selected. An adjustable current limit helps protect the diode from accidental overdrive. The LDI-800 contains a thermoelectric cooler driver which is compatible with many laser products.

Features which help protect laser diodes are: power line filtering, low line voltage detection, open circuit detection, high speed current limit, built-in dummy setup diode, missing monitor photodiode detection and automatic shorting of the laser diode terminals during output switching.

A front panel key switch and rear panel remote interlock connector are provided to assist safe use of the LDI-800 and associated laser diode.

Rear panel connectors allow monitoring the laser current and power, and provide direct

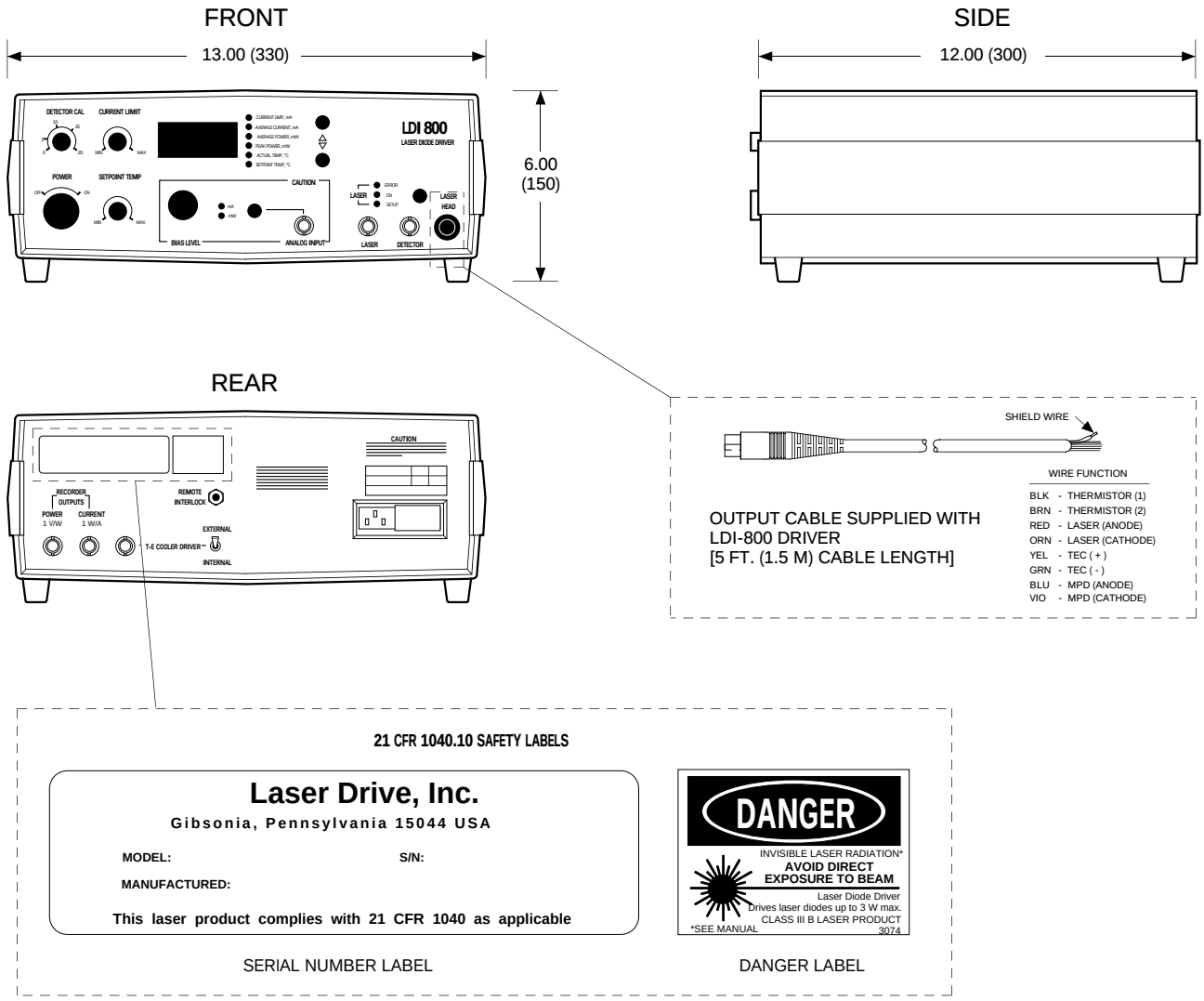
Section 4

Specifications

	LDI-800	LDI-800M
CURRENT CONTROL MODE		
Display Mode	Average Current	Average Current
Range	0 to 1000 mA	0 to 1999 mA
Resolution (Accuracy)	1 mA (± 5 mA + 0.5% of reading)	1 mA (± 5 mA + 2% of reading)
Bias Level Range	10 to 1000 mA	10 to 1985 mA
Analog Input Range[1]	0 to 1000 mA	0 to >2000 mA
Scale Factor (Accuracy)	1 mA/mV (± 10 mA + 3% of reading)	1 mA/mV (± 10 mA + 3% of reading)
Bandwidth (Typical)	100 kHz	50 kHz
Stability, Short Term (Typical)	100 PPM + 1µA/°C or 5 µA p-p	100 PPM + 1µA/°C or 5 µA p-p
OPTICAL POWER CONTROL MODE		
Display Mode	Average Power	Average Power
Range	0 to 200 mW	0 to >500 mW
Resolution (Accuracy)	1 mW (± 1 mW + 5% of reading)	1 mW (± 1 mW + 5% of reading)
Display Mode	Peak Power	Peak Power
Range	0 to 200 mW	0 to >500 mW
Resolution (Accuracy)	1 mW (± 4 mW + 5% of reading)	1 mW (± 4 mW + 5% of reading)
Detector Calibration Range	2 to 20 µA/mW	2 to 20 µA/mW
Bias Level Range	2 to 200 mW	2 to > 500 mW
Analog Input Range	0 to 200 mW	0 to 500 mW
Scale Factor (Accuracy)	0.2 mW/mV (± 2 mW + 3% of reading)	0.25 mW/mV (± 2 mW + 3% of reading)
Bandwidth (Typical)	100 kHz	50 kHz
Stability	100 PPM + 1 µW/°C	100 PPM + 1 µW/°C
CURRENT LIMIT		
Display Mode	Current Limit	Current Limit
Range	25 to 1000 mA	< 50 mA to at least 1995
Resolution (Accuracy[2])	1 mA (± 5 mA + 0.5% of reading)	1 mA (± 5 mA + 2% of reading)
TEMPERATURE CONTROL		
Display Mode	Actual or Setpoint	Not Available
Range	-20 to 40 °C	
Resolution	0.1 °C	
Accuracy[3]	± 1 °C from -10 to 30 °C	
	± 2 °C from -20 to 40 °C	
Setpoint Temp. Adjustment Range	-10 °C to 30 °C	
Thermoelectric Cooler Current	0 to 1.5 A continuous	
Ext. TEC Drive (rear panel)		
Range	0 to 3 V	
Scale Factor (Accuracy)	1 V/V (± 10 mV)	
MONITOR OUTPUTS		
Output Impedance	1 kΩ	1 kΩ
Current		
Scale Factor (Accuracy)	1 mV/mA (± 1 mA)	1 mV/mA (± 1 mA)
Power		
Scale Factor (Accuracy)	1 mV/mW (± 1 mW)	1 mV/mW (± 1 mW)
REMOTE INTERLOCK		
Open Circuit Voltage	5 V ± 10%	5 V ± 10%
Short Circuit Current	< 1 mA	< 1 mA
Open Interlock	Turns Laser OFF	Turns Laser OFF
GENERAL		
Operating Temperature	10 to 40 °C	10 to 40 °C
Storage Temperature	-40 to 75 °C	-40 to 75 °C
Power	100, 120, 220, 240 VAC + 5%, -10%	100, 120, 220, 240 VAC + 5%, -10%
	48 to 66 Hz	48 to 66 Hz
	45 W maximum @ 120 VAC	45 W maximum @ 120 VAC
	60 VA maximum @ 120 VAC	60 VA maximum @ 120 VAC
Size (H x W x D)	6" x 13" x 12"	6" x 13" x 12"
	(150 mm x 330 mm x 300 mm)	(150 mm x 330 mm x 300 mm)
Weight	8 lb. (4 kg)	8 lb. (4 kg)

NOTES

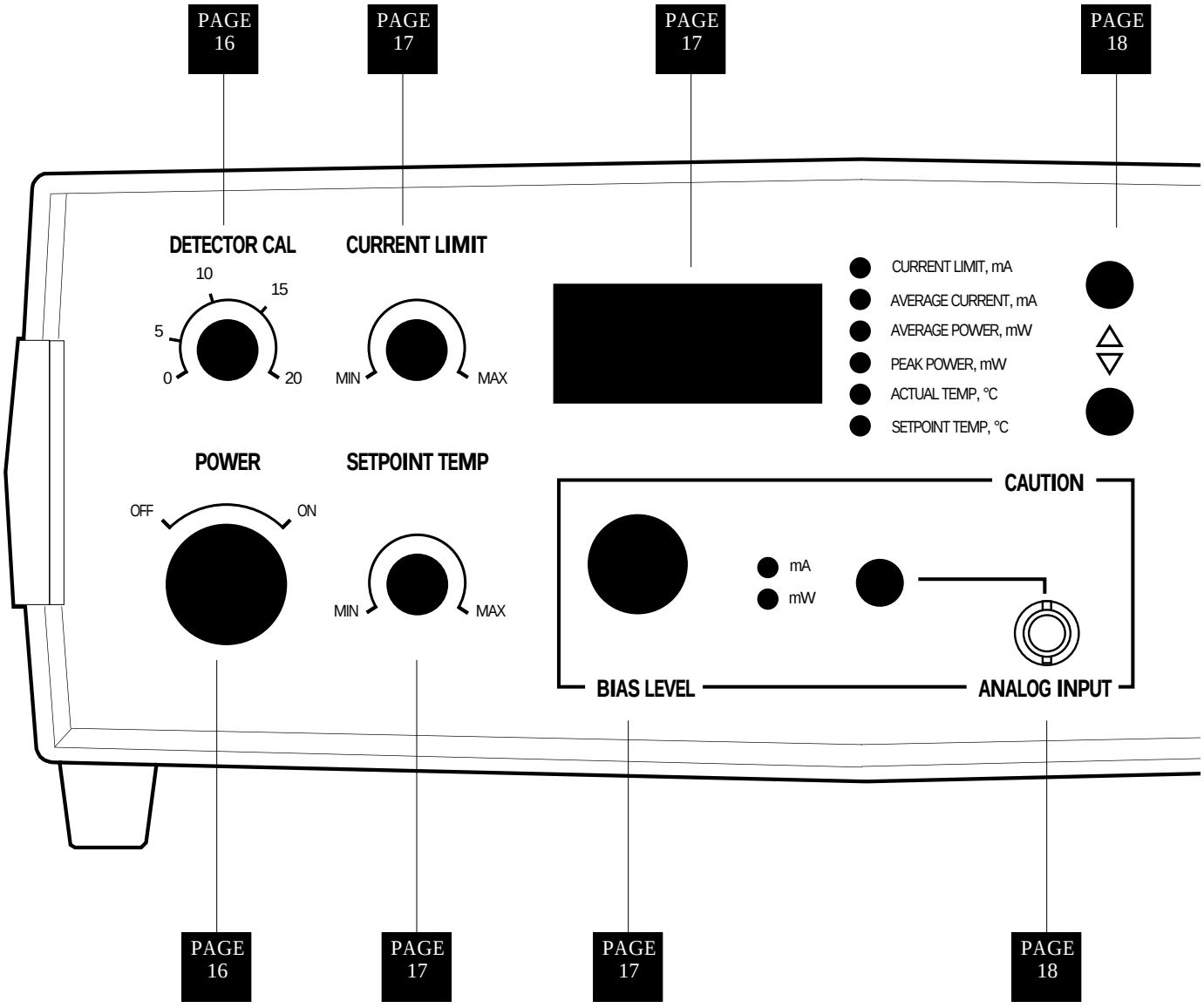
1. The sum of bias and analog currents will limit at the current limit setting
2. Total error between displayed current limit and displayed average current in current limit mode may be as high as the sum of the accuracies for these two values.
3. The thermistor presently used by LDI has a ±5% tolerance at 25 °C, ±8% at -10 °C, and ±6% at 30 °C. Corresponding temperature errors are ±1.2, ±1.5, and ± 1.5 °C.
4. Both drivers are designed to apply a negative bias to the laser diode Cathode Lead while the Anode Lead is at ground.

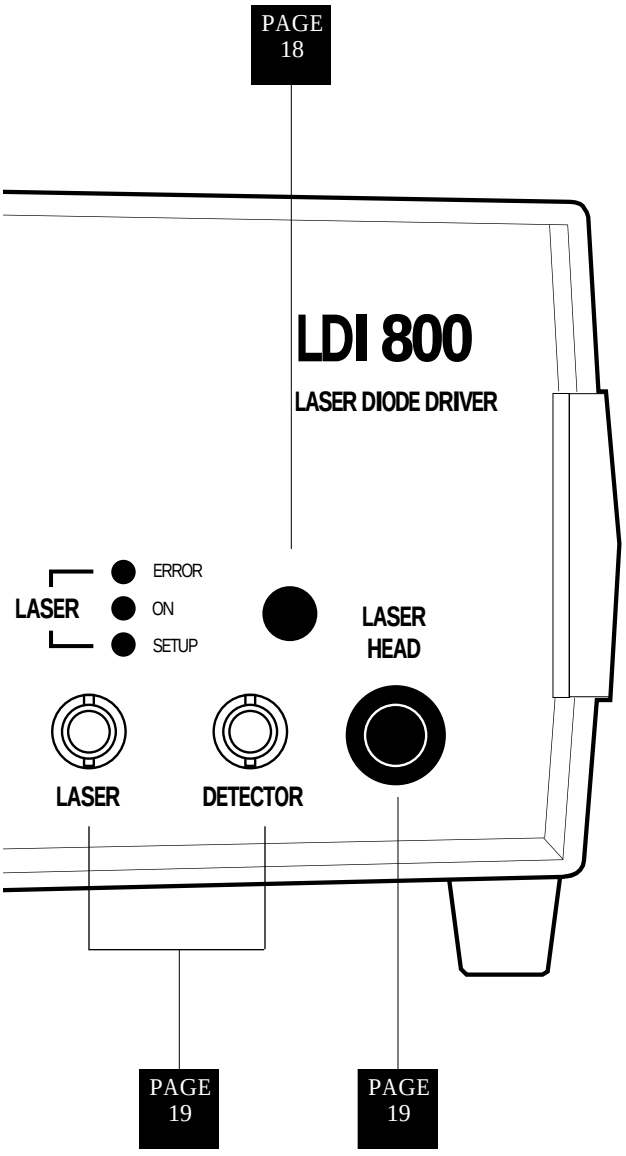

FRONT
13.00 (330)
DETECTOR CAL
CURRENT LIMIT
LDI 800
LASER DIODE DRIVER
POWER
SETPOINT TEMP
CAUTION
BIAS LEVEL
ANALOG INPUT
LASER
DETECTOR
LASER HEAD
6.00
(150)
SIDE
12.00 (300)
REAR
RECORDER OUTPUTS
POWER 1 V/W
CURRENT 1 W/A
REMOTE INTERLOCK
EXTERNAL
T-E COOLER DRIVER
INTERNAL
CAUTION
SHIELD WIRE
OUTPUT CABLE SUPPLIED WITH
LDI-800 DRIVER
[5 FT. (1.5 M) CABLE LENGTH]
WIRE FUNCTION
BLK - THERMISTOR (1)
BRN - THERMISTOR (2)
RED - LASER (ANODE)
ORN - LASER (CATHODE)
YEL - TEC (+)
GRN - TEC (-)
BLU - MPD (ANODE)
VIO - MPD (CATHODE)
21 CFR 1040.10 SAFETY LABELS
Laser Drive, Inc.
Gibsonia, Pennsylvania 15044 USA
MODEL:
S/N:
MANUFACTURED:
This laser product complies with 21 CFR 1040 as applicable
SERIAL NUMBER LABEL
DANGER
INVISIBLE LASER RADIATION*
AVOID DIRECT EXPOSURE TO BEAM
Laser Diode Driver
Drives laser diodes up to 3 W max.
CLASS III B LASER PRODUCT
*SEE MANUAL
3074
DANGER LABEL

Section 5

LDI-800 Front Panel Description

This section describes the operation of each front panel feature.
Reading this section is an excellent way to become familiar with the operation of the LDI-800.




PAGE
18
LDI 800
LASER DIODE DRIVER
LASER
ERROR
ON
SETUP
LASER
HEAD
LASER
DETECTOR
PAGE
19
PAGE
19

5.1 Main POWER Key Switch

This switch controls the line power. It is a key switch and the key is removable only in the OFF position to allow safe use of the LDI-800. A separate switch, the laser control, is used to control power to the laser diode.

5.2 DETECTOR CAL

This control calibrates the optical power mode for use with monitor photodiodes with a range of calibration factors from 2 to 20 μA/mW.

CAUTION

IF THE CONTROL IS IMPROPERLY SET, THE LASER DIODE MAY BE DRIVEN TO CURRENT LIMIT WHEN POWER FEEDBACK IS SELECTED.

Four methods may be used to set the detector calibration control:

1. The calibration factor may be set directly from the laser's data sheet. This is the simplest way, but is subject to limits in reading the scale on the front panel.

2. The laser diode may be operated in current mode at the operating current given on the data sheet while monitoring power and adjusting the detector calibration control to read the correct power. Note that the diode should be operated at the temperature specified on the data sheet. This method eliminates scale reading but is subject to variation in output power with temperature and time.

3. The laser may be operated in current mode while monitoring optical power and adjusting the detector calibration control to match the actual output power as indicated by an external calibrated power detector. This method is accurate but requires a calibrated power meter. Make sure the power meter intercepts all the output from the laser. The detector should intercept a solid angle of approximately 85°.

4. With no laser connected, a 1 kΩ resistor in series with an ammeter may be connected to the front panel DETECTOR BNC connector. Divide the ammeter reading in μA by the data sheet monitor photodiode value in μA/mW. Adjust the detector calibration control until the average power reading matches the calculated answer. For example, a reading of 2,500 μA (2.5 mA) and 10 μA/mW

corresponds to 250 mW. This method accurately sets the control to match the MPD calibration number but requires a resistor and an ammeter.

5.3 CURRENT LIMIT

Drive current for both the dummy setup diode and the laser diode will not exceed the value set by this control. This control should be set before switching power from the dummy load to the laser diode. The setpoint may be read on the display by selecting the CURRENT LIMIT, mA display mode.

The ERROR light will start to blink when the actual current is within about 10 mA of the current limit value. A suggested setting is the data sheet value for operating current plus 10 mA. If the operating current is not specified, a low initial setting is recommended. If current limit is activated, the ERROR light will blink.

CAUTION

THE CURRENT LIMIT SETTING SHOULD BE CHANGED WHEN CHANGING LASERS.

5.4 SETPOINT TEMP

This control sets the temperature the thermoelectric cooler controller will attempt to maintain. The setpoint value is read out on the main display by selecting the SETPOINT TEMP, °C display mode. In order to work accurately, this control must be used with the thermistor described in Section 4.0, Note 3.

5.5 Digital Display

This display allows observation of one of the parameters indicated to the right of the display. The active parameter is indicated by a lighted LED annunciator. Parameters are selected by pressing one of two buttons located to the right of the display window which move the annunciator up or down one line per press.

5.6 BIAS LEVEL

This 10-turn control adjusts the bias level for either operating current or power, depending on the control mode selected. The bias level varies from 0 to full scale.

CAUTION

WHEN CHANGING CONTROL MODE, THE BIAS LEVEL SHOULD BE TURNED CCW TO ITS MINIMUM VALUE BECAUSE THE REQUIRED SETPOINT FOR ONE CONTROL MODE WILL DIFFER FROM THE SETPOINT FOR THE OTHER MODE.

NOTE: The bias current may be set to indicate a negative value of up to -10 mA on

some units. This current does not actually flow through the laser diode.

5.7 mA/mW, Control Mode Select Push Button

This button changes the control mode between current and optical power. The optical power mode may be entered only when the laser diode is "on" and if a monitor photodiode is present. An annunciator is located to the left of mA and mW. One will be lighted to indicate the active mode. (See caution regarding BIAS LEVEL in Section 5.6).

NOTE: If the display is reading peak power and the control mode is switched from mA to mW, a transient will be seen on the display. It is caused by the MPD test and does not indicate a laser diode pulse.

5.8 ANALOG INPUT

This BNC connector allows an external signal to be added to the bias level. It is direct coupled and may be used to set the bias level remotely or to sweep the drive. The 0 to 1 volt input range corresponds to 0 to full scale for the active control mode.

CAUTION

THE ANALOG INPUT MAY OVERDRIVE THE LASER IF EXCESSIVE VOLTAGE IS APPLIED. CURRENT LIMIT OPERATES ON THE SUM OF THE BIAS LEVEL AND ANALOG INPUTS AND WILL PROTECT THE LASER DIODE IF PROPERLY SET.

5.9 LASER: ERROR, ON, SETUP

This button selects whether the internal dummy load or the laser diode is connected to the drive circuitry. One of three indicator lights located to the left of each label will be lighted.

- SETUP means the internal load is connected.
- ON means the laser is connected. If the SETUP light is blinking when the ON light is lit, power will be applied to the laser diode after a 10 second delay. The delay is provided to comply with safety requirements.
- ERROR means some error, such as current limit, has occurred or is occuring.

Some errors prevent switching the output to ON. See Section 8.0 for more information on error conditions.

5.10 LASER and DETECTOR

These two BNC connectors duplicate the laser output and monitor photodiode input connections of the LASER HEAD connector. They allow alternative access to the laser drive and detector amplifier circuits. The LASER BNC can be used to drive a laser through a coaxial cable. The DETECTOR BNC can be used as an input connector for an external photodiode.

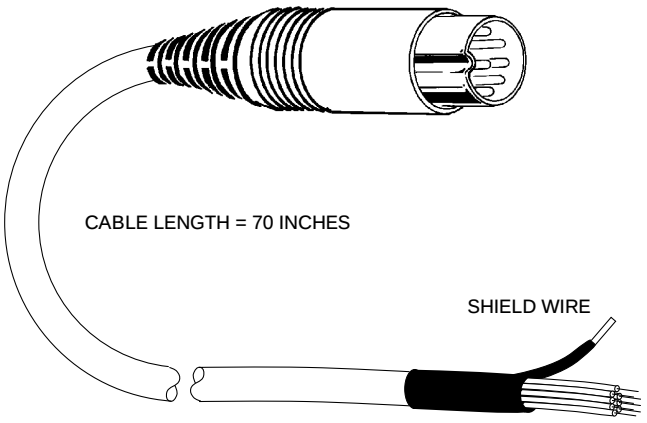
CAUTION

THESE CONNECTORS ARE CONNECTED DIRECTLY ACROSS THE LASER DIODE AND MONITOR PHOTODIODE TERMINALS OF THE LASER HEAD CONNECTOR.

5.11 LASER HEAD

This connector allows connecting optional heatsinks or cables to the LDI-800. It carries laser drive, thermoelectric cooler drive, monitor photodiode and thermistor

Figure 5.1 Output Cable Assembly



LDI-800-H

COLOR	FUNCTION
BLK	THERMISTOR (1)
BRN	THERMISTOR (2)
RED	LASER (ANODE)
ORN	LASER (CATHODE)
YEL	TEC (+)
GRN	TEC (-)
BLU	MPD (ANODE)
VIO	MPD (CATHODE)

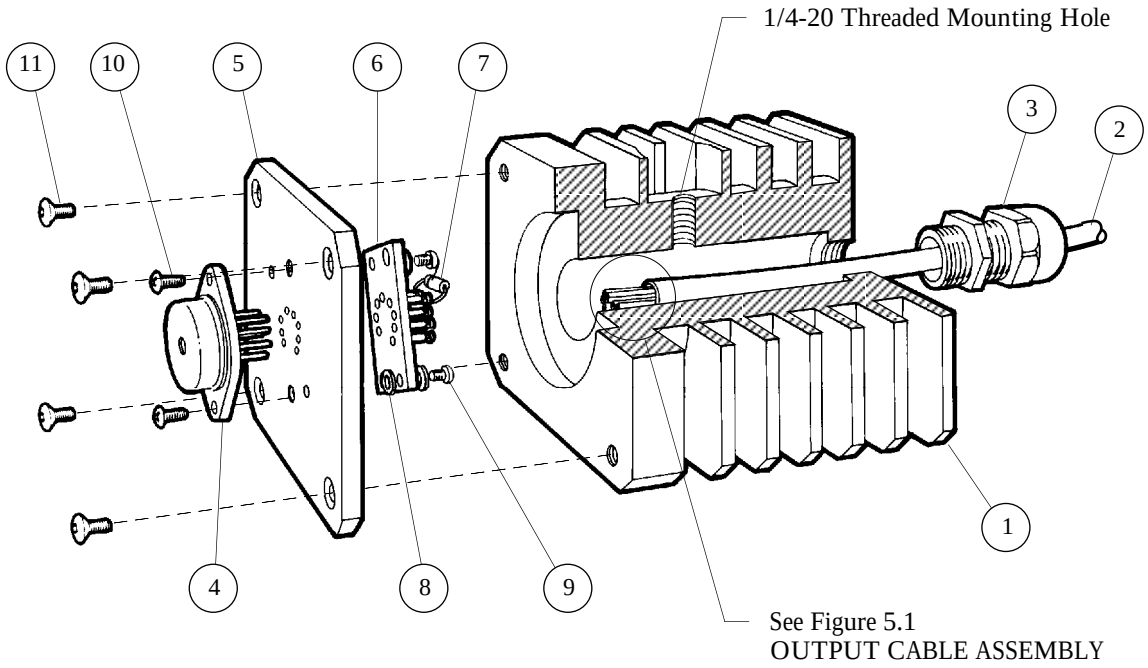
LDI-800-C

COLOR	FUNCTION
BLK	NOT USED
BRN	NOT USED
RED	LASER (ANODE)
ORN	LASER (CATHODE)
YEL	NOT USED
GRN	NOT USED
BLU	NOT USED
VIO	NOT USED

LDI-800-G

COLOR	FUNCTION
BLK	NOT USED
BRN	NOT USED
RED	LASER (ANODE)
ORN	LASER (CATHODE)
YEL	NOT USED
GRN	NOT USED
BLU	MPD (ANODE)
VIO	MPD (CATHODE)

Figure 5.2 LDI-800-H Heatsink Assembly



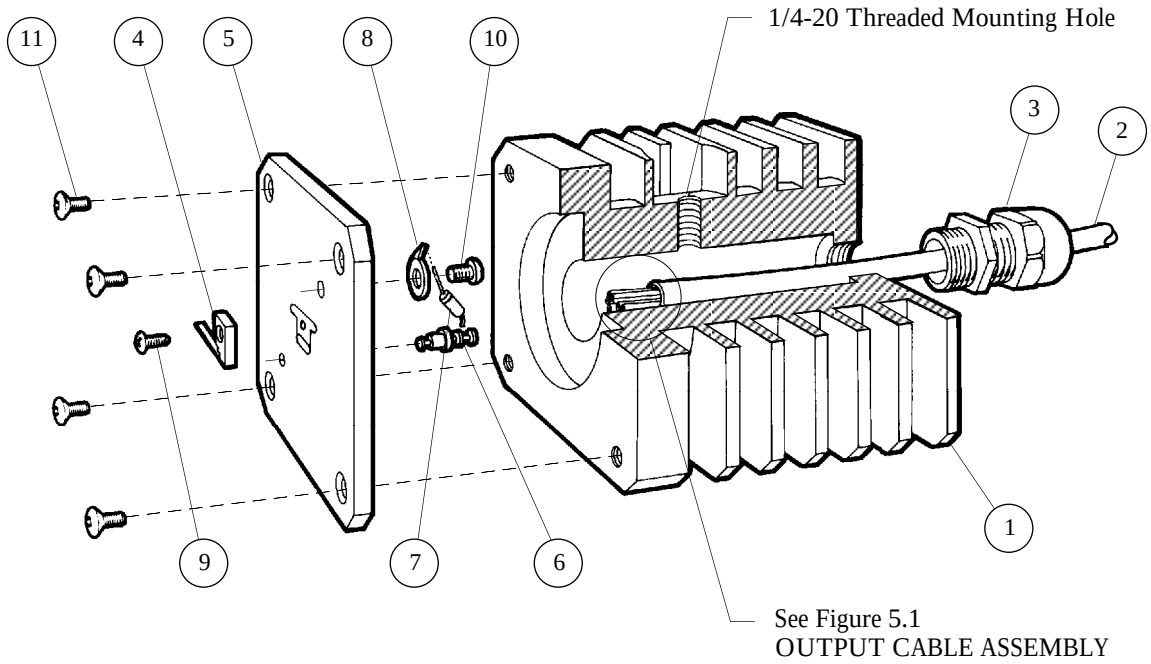
ITEM	QTY	DESCRIPTION
1	1	HEATSINK BODY (#0439-0006)
2	1	CABLE ASSEMBLY (#0439-0020)
3	1	STRAIN RELIEF (#2522-0033)
4	1	LASER DIODE
5	1	FRONT MOUNTING PLATE (#0439-0132)
6	1	SOCKET ASSEMBLY, 8 PIN (#0439-0129)
7	1	DIODE, IN4148 (#4802-1870)*
8	4	WASHER, 2-56
9	2	P.H., 2-56 x 1/4"
10	2	P.H., 6-32 x 5/16"
11	4	F.H., 8-32 x 1/2"

SIZE: 2.5"H x 2.5"W x 3.0"D (64mm x 64mm x 76mm)
WEIGHT: 1.4 lbs (.64 kg)

INSTALLATION NOTE:
Wear a grounded wrist strap when handling the laser diode. Connect the laser head to the LDI-800, (plugged in) to ground the head. Tighten laser mounting screws to insure adequate heatsinking.

*The IN4148 diode is installed to reduce possible static discharge transients.

Figure 5.3 LDI-800-C Heatsink Assembly



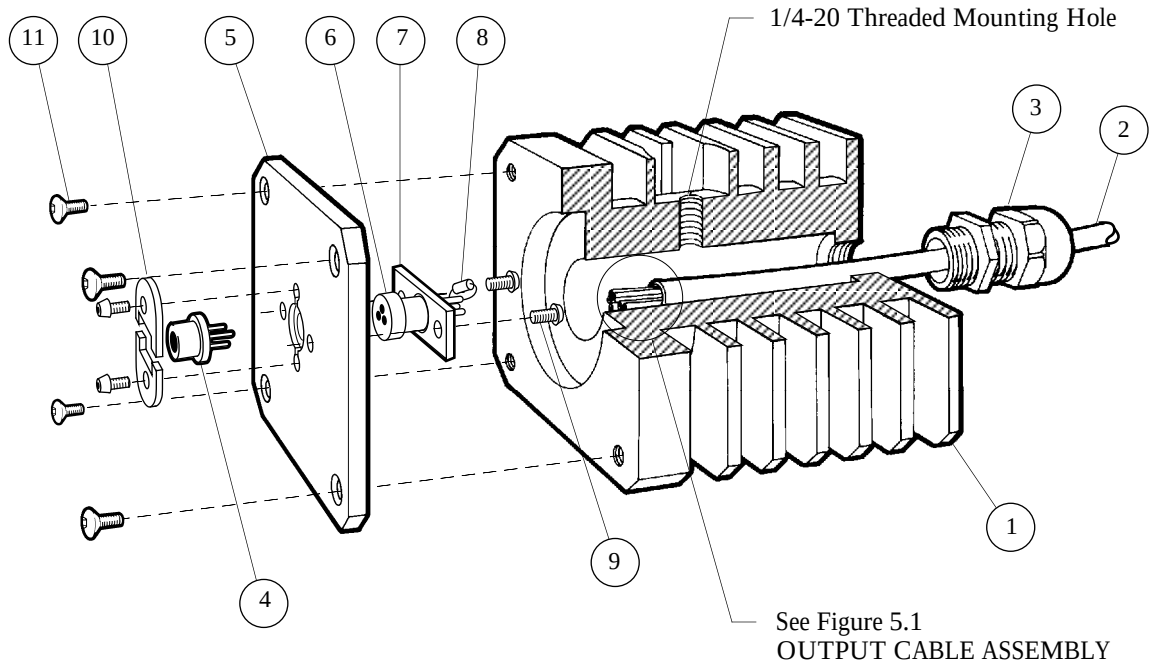
ITEM	QTY	DESCRIPTION
1	1	HEATSINK BODY (#0439-0006)
2	1	CABLE ASSEMBLY (#0439-0020)
3	1	STRAIN RELIEF (#2522-0033)
4	1	LASER DIODE
5	1	FRONT MOUNTING PLATE (#0439-0131)
6	1	INSULATED TERMINAL (#0439-0653)
7	1	DIODE, IN4148, CATHODE TO LUG (#4802-1870)*
8	1	SOLDER LUG, 6-32 (#2108-0730)
9	1	P.H., 2-56 x 1/4"
10	1	P.H., 6-32 x 3/16"
11	4	F.H., 8-32 x 1/2"

SIZE: 2.5"H x 2.5"W x 3.0"D (64mm x 64mm x 76mm)
WEIGHT: 1.4 lbs (.64 kg)

INSTALLATION NOTE:
Wear a grounded wrist strap when handling the laser diode. Attach the laser diode to the laser head before soldering the lead. Connect the laser head to the LDI-800, (plugged in) to ground the head. Use a grounded low power soldering iron (40 Watts or less is recommended) and do not let smoke from the flux get on the laser diode.

*The IN4148 diode is installed to reduce possible static discharge transients.

Figure 5.4 LDI-800-G Heatsink Assembly



ITEM	QTY	DESCRIPTION
1	1	HEATSINK BODY (#0439-0006)
2	1	CABLE ASSEMBLY (#0439-0020)
3	1	STRAIN RELIEF (#2522-0033)
4	1	LASER DIODE
5	1	FRONT MOUNTING PLATE (#0439-1809)
6	1	SOCKET, 3 PIN (#0439-1672)
7	1	SOCKET CLAMP PLATE (#0439-1814)
8	1	DIODE, IN4148 (#4802-1870)*
9	4	P.H., 6-32 x 1/4"
10	2	G CLAMP PLATE (#0439-1813)
11	4	F.H., 8-32 x 1/2"

SIZE: 2.5"H x 2.5"W x 3.0"D (64mm x 64mm x 76mm)
WEIGHT: 1.4 lbs (.64 kg)

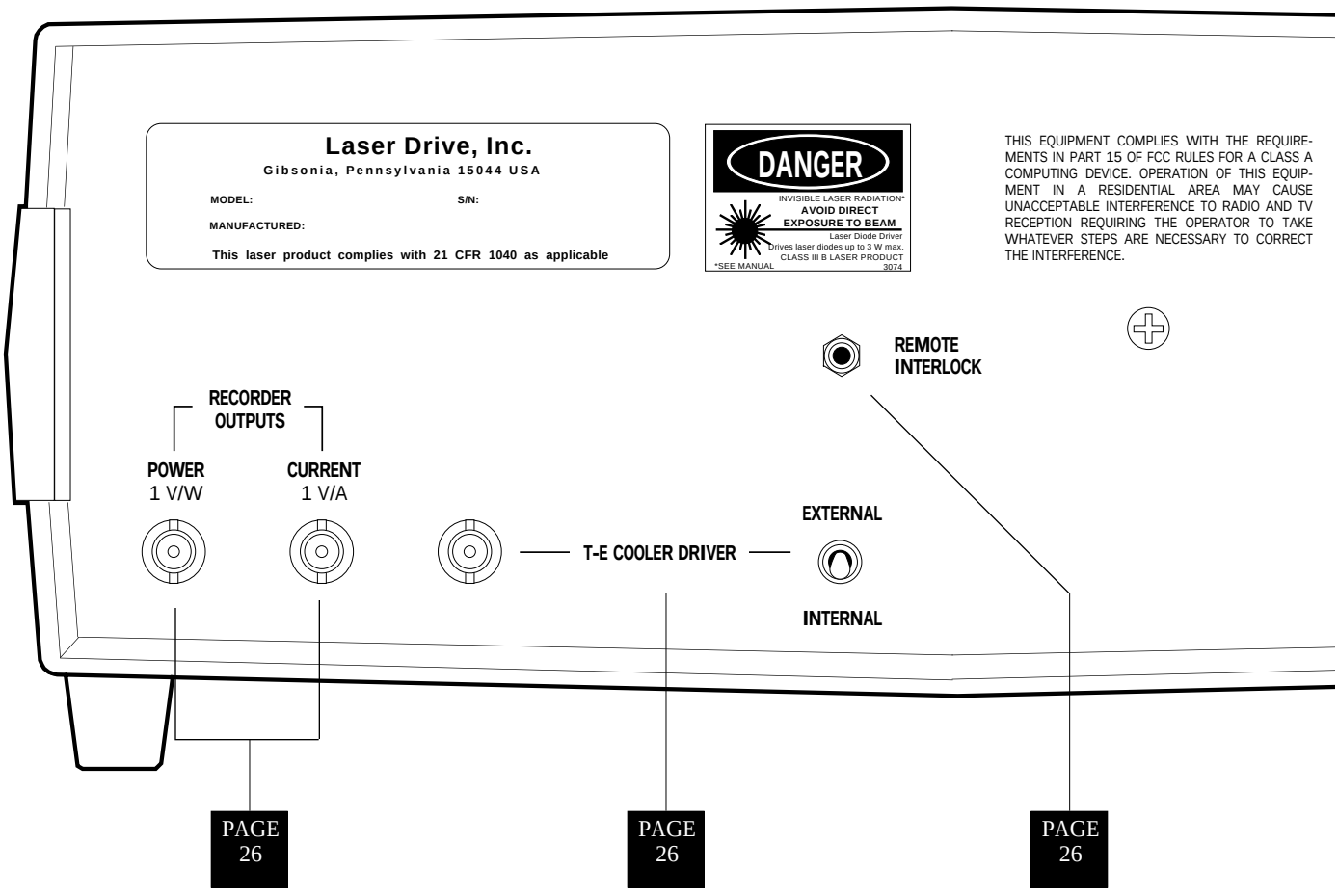
INSTALLATION NOTE:
Wear a grounded wrist strap when handling the laser diode. Connect the laser head to the LDI-800, (plugged in) to ground the head. Tighten laser mounting screws to insure adequate heatsinking.

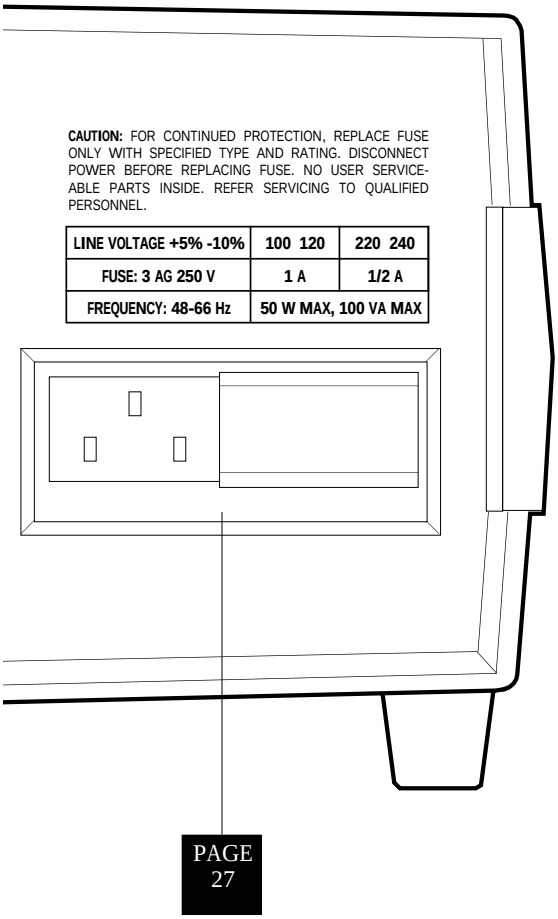
*The IN4148 diode is installed to reduce possible static discharge transients.

Section 6

LDI-800 Rear Panel Description

This section describes the operation of each rear panel feature.
Reading this section is an excellent way to become familiar with the operation of the LDI-800.





CAUTION: FOR CONTINUED PROTECTION, REPLACE FUSE ONLY WITH SPECIFIED TYPE AND RATING. DISCONNECT POWER BEFORE REPLACING FUSE. NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED PERSONNEL.

LINE VOLTAGE +5% -10%	100 120	220 240
FUSE: 3 AG 250 V	1 A	1/2 A
FREQUENCY: 48-66 Hz	50 W MAX, 100 VA MAX	

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6.1 RECORDER OUTPUTS

These connectors allow monitoring the laser diode drive current and output power (if the laser is equipped with a monitor photodiode.) Both signals have an output impedance of about 500 Ω and are designed to be used with high input impedance measuring equipment. The outputs are short circuit protected.

- POWER: This BNC output provides a voltage proportional to the monitor photodiode signal. Assuming the detector calibration adjustment on the front panel is set correctly, the scale factor is 1 mV/mW

- CURRENT: This BNC output provides a voltage proportional to the current flowing through either the internal dummy load or the laser diode. The scale factor is 1 mV/mA.

6.2 T-E COOLER DRIVER

A BNC connector and a toggle switch are associated with the TE cooler drive circuit.

The BNC connector allows an external signal to be applied to the thermoelectric cooler drive circuit when the TE cooler source switch is placed in the EXTERNAL position. A signal between 0 and 3 volts will be buffered with unity gain and applied to the TE cooler connections of the LASER HEAD connector. Positive voltage results in cooling action. Negative input voltages result in a TE drive voltage of about 0. Heating action must be provided by the power dissipated by the laser diode.

The toggle switch connects the thermoelectric cooler driver either to the internal temperature control signal when in INTERNAL position or to an external drive signal when in the EXTERNAL position.

CAUTION

OPERATING A TE COOLER-EQUIPPED LASER DIODE WITH THE SWITCH IN THE EXTERNAL POSITION MAY CAUSE THE LASER DIODE TO OVERHEAT. COOLING WILL NOT OCCUR IN THE EXTERNAL POSITION UNLESS AN APPROPRIATE INPUT SIGNAL IS PROVIDED.

6.3 REMOTE INTERLOCK

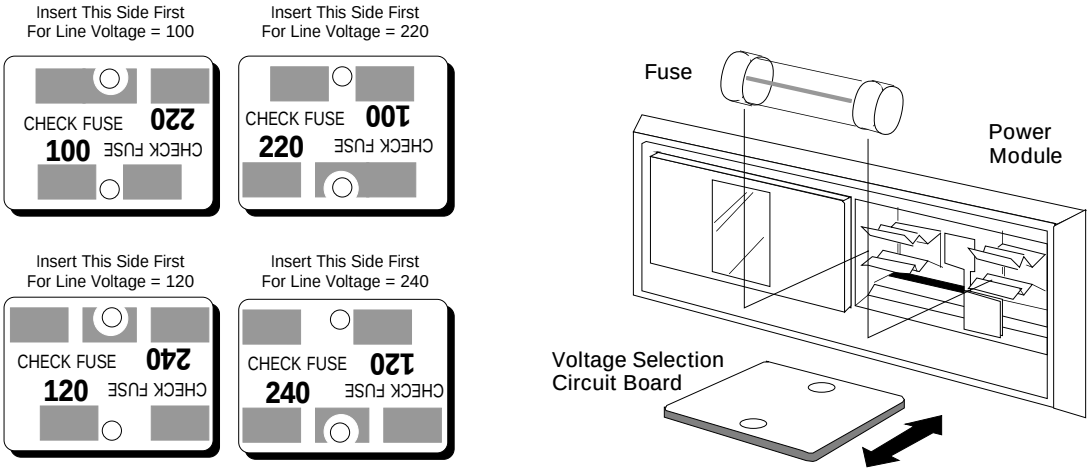
This connector is provided to comply with safety requirements. The plug supplied is jumpered internally and it must be in place for the power supply to drive a laser. If it is desired to use the interlock feature, remove the jumper in the connector and

replace it with a circuit which will be closed in the "safe" position and open when the interlock is broken.

6.4 Power Module

The power module allows changing line cords to match local outlets, holds the main line fuse and allows matching line voltage to one of four choices by removing a small circuit board in the module. Use a pair of pliers to extract the voltage selecting circuit board if it needs to be changed.

Figure 6.1 Power Module



Section 7

Application Notes

WARNING

VERIFY THAT THE LINE VOLTAGE SELECTION AND FUSE ARE CORRECT FOR YOUR INSTALLATION BEFORE APPLYING POWER TO THE UNIT. MAKE ALL REQUIRED CHANGES WITH POWER REMOVED FROM THE EQUIPMENT.

7.1 Noise Susceptibility

Noise may be seen on the monitor outputs when using an oscilloscope. The internal noise is typically under 1 mV p-p. Noise may be coupled into the circuits from external sources located near the power supply. One cause is ungrounded conductive surfaces on which the LDI-800 may be placed. Another cause is ground loops which are formed between the rear panel safety ground connection of the power cable, rear panel cable connections, the laser head case, or the drive cable shield.

7.2 Measuring The Voltage Across A Laser Diode

When using the LASER HEAD connector, the voltage across the laser diode may be observed at the LASER BNC connector. The drive current flowing through the standard output cable induces an error of about 0.1 mV/mA of laser current.

CAUTION

THIS PROCEDURE IS MENTIONED BUT NOT RECOMMENDED BECAUSE THE LASER BNC CONNECTOR IS DIRECTLY ACROSS THE LASER. USE EXTREME CARE WHEN USING THIS PROCEDURE. INSTALLING A 10 KΩ RESISTOR BETWEEN THE CENTER BNC TERMINAL AND THE MEASURING EQUIPMENT IS A PRECAUTIONARY MEASURE.

7.3 Using The TE Cooler To Control Wavelength

The wavelength of laser diodes varies about 0.3 nm/°C of temperature shift. The SETPOINT TEMP control may be used to wavelength tune a laser. Alternatively, the EXTERNAL TE cooler drive input (rear panel) may be connected to a user-supplied circuit which controls wavelength directly. One way to implement a wavelength sensor is to subtract the outputs of two photodiodes recording light through two optical bandpass filters. One should have a center frequency higher than that desired and the other, lower. The passbands should overlap.

7.4 Using Other Monitor Photodiodes

Other photodiodes may be connected to the DETECTOR BNC or the appropriate leads of the output cable (see Figure 5.1) The photodiode should be rated for at

Section 8
Error Conditions

least 5 V reverse bias and have a rise time into 50 Ω of less than 50 nsec. The effective output in μA/mW must fall in the range of the DETECTOR CAL control to ensure front panel display accuracy.

Consult LDI for other applications.

The ERROR light associated with the output control button is activated by the conditions shown below. The errors may be simulated using the procedures in Section 9.1.

8.1 Error Light Blinking Rapidly

This condition will occur as long as the driver is in current limit. (Transient current limiting will cause the ERROR light to blink for about 1 second).

8.2 Error Light Blinking Slowly

This condition will occur for two reasons:

1. Open Laser Circuit - An attempt is made to switch from SETUP to ON with no laser diode. The output will remain in SETUP. One exception occurs if the bias current is set to 0. In this case the open circuit detector triggers only if the drive signal forward biases the laser diode. Reverse biasing is eliminated without generating an error.

2. Missing Monitor Photodiode - An attempt is made to switch from current mode to power mode while in SETUP, or while in ON without a monitor photodiode. The mode control will remain in current mode (mA).

8.3 Error Light On Steadily

This condition will occur for two reasons:

1. Low Main Power Supply Voltage - The AC power input drops below about 80% of nominal. The output control will switch from ON to SETUP if necessary, and

Section 9

Performance Verification and Calibration

the output drive will switch off. The unit "locks up" until the line voltage increases.

2. Remote Interlock Plug Missing (interlock circuit open) - Results in same consequences as reason # 1. Replace the interlock plug to restore normal operation. See paragraph 6.3 and 9.1-13.

9.1 LDI-800 Check-out Procedure

This procedure verifies the basic operation of the power supply. Each item listed below should be performed by the operator prior to use of the driver with a laser diode. If a reading appears to be in error, check the Specifications, (Section 4.0) for the allowable error.

1. Power Up - After verifying the selection of proper line voltage and fuse, and inserting the remote interlock plug, plug in the unit and turn the POWER key switch to ON. The digital display and the CURRENT LIMIT and SETUP annunciators should light.

2. Display - Turn the CURRENT LIMIT adjust control knob from full CCW to full CW. The display should vary from about 0 to about 1000 (mA) as the knob is rotated.

3. Current Mode - Adjust CURRENT LIMIT to about 1000 mA then switch the display to AVERAGE CURRENT. Vary the BIAS LEVEL control approximately 10 turns from CCW to full CW. The display should vary from about 0 to 1000 (mA).

4. Current Limit - With the BIAS LEVEL full CW, vary the CURRENT LIMIT from full CCW to full CW. The ERROR light should blink. The average current should vary from about 0 to 1000 (mA).

5. Photodetector Amplifier and Detector Cal - Switch the display to AVERAGE POWER. With no laser connected, the display should read about 0 (mW). Connect a 1 kΩ, 1/4 W resistor across the DETECTOR BNC connector. With the DETECTOR CAL knob full CCW, the display should read about 1250 (mW). Rotate the DETECTOR CAL knob full CW. The display should read about 125 (mW).

6. Peak Power - Connect a 1 kΩ, 1/4 W resistor across the DETECTOR BNC connector. Switch display to PEAK POWER. Rotate the DETECTOR CAL knob full CCW, pause, then rotate it quickly full CW. The display should drop from about 1250 to about 125 (mW) over a period of about one second.

7. Setpoint Temp - Switch the display to SETPOINT TEMP. Vary the SETPOINT TEMP control from full CCW to full CW. The display should vary from about -10.0 to 30.0 (°C).

8. Actual Temp - Switch the display to ACTUAL TEMP. With no laser installed, the display should read about -35.5 °C. Connect the output cable to the LASER HEAD connector. Short the black and brown leads together. The display should read about 68 °C. Connect a 10 kΩ resistor to the black and brown leads (remove short first). The display should read about 25 °C.

9. TE Cooler Drive - Connect the output cable to the LASER HEAD connector. Connect a 10 kΩ resistor between the black and brown leads and a 1 Ω, 10 W resistor between the green and yellow leads. Connect a voltmeter with a 10 volt scale, negative to green and positive to yellow. Set the display to ACTUAL TEMP and record the reading. Switch the rear panel TE drive switch to INTERNAL.

   Switch the display to SETPOINT TEMP and adjust the SETPOINT TEMP control to about -10 °C. The voltmeter reading should be about 1.6 V. Adjust the setpoint to 5° above the ACTUAL value. The voltmeter should read about -50 mV. Adjust the setpoint to the ACTUAL reading. Vary the setpoint slightly about the ACTUAL reading.
   The voltmeter reading should ramp up and down between the two voltage readings observed above.

10. Missing Monitor Photodiode Error - With no laser connected, press the control mode button to switch from mA to mW. The ERROR light should blink.

11. Turn-on Delay and Open Circuit Error - With no laser connected, press the output control button to switch from SETUP to ON. The SETUP light should blink for about 10 seconds, followed by slow blinking from the ERROR light for about 2 seconds. The BIAS LEVEL must be adjusted to a positive average current in SETUP before the open circuit will function.

12. Low Line Voltage Error - If available, connect the unit to power from a variable AC source (e.g., autotransformer). Lower the supply voltage from nominal. At about 80% of nominal line voltage, the ERROR light should come on steadily (it may cycle off and on slowly at threshold). The threshold varies with load conditions inside the LDI-800.

13. Remote Interlock - Remove the REMOTE INTERLOCK plug. The ERROR light should come on steadily. Replace the remote interlock plug.

9.2 LDI-800 Calibration Procedure

Four adjustments are provided for calibration of the LDI-800. In addition to the four internal adjustments, the DETECTOR CAL knob must be repositioned to match the panel scale whenever the knob is removed. All adjustments should be made after the unit has been on for at least 1/2 hour.

WARNING

DANGEROUS VOLTAGES ARE PRESENT IN THIS PRODUCT EVEN WHEN THE POWER SWITCH IS OFF. ONLY EXPERIENCED SERVICE PERSONNEL SHOULD ATTEMPT CALIBRATION.

1. Two Volt Reference - Connect a voltmeter with accuracy of at least 1 mV when reading 2 volts to Test Point 2 (TP2) and TP3. Adjust the 2 V ADJ control to set the measured voltage to 2 V ± 1 mV.

2. Current Limit Adjust - Using the digital display, set the CURRENT LIMIT to 200 mA ±5 mA . Record the exact value. Switch the display to AVERAGE CURRENT and increase the BIAS LEVEL control until the ERROR light blinks, then one turn CW more. This step forces the current limit loop to operate.

   Adjust the CURRENT LIMIT OFFSET control until the average current matches the current limit setpoint within 1 mA.

3. Power Offset Adjust - Turn the DETECTOR CAL control knob full CCW. Connect a voltmeter with accuracy of at least 0.1 mV when reading 100 mV to TP1 and TP3.

   Adjust the POWER OFFSET control for a reading of 0 ± 0.5 mV.

4. Detector Calibration Adjust - Turn the DETECTOR CAL control knob full CCW. Move the DETECTOR CAL jumper to the TEST position. Connect a voltmeter with accuracy of at least 1 mV when reading 1 V and 0.1 mV when reading 100 mV to TP1 and TP3 Record the reading.

   Turn the DETECTOR CAL knob full CW. Adjust the internal DETECTOR TRIM control until the reading is exactly one-tenth the value recorded when the knob was full CCW, ±0.1 mV.

   Return the DETECTOR CAL jumper to its normal position (NORM.)

5. Detector Cal Knob Adjust - Remove the DETECTOR CAL jumper and connect an ammeter in series with the inboard and middle pins. Divide the current reading

Section 10
Service

in μA by 10 (μA/mW) and record the result.

If replacing the DETECTOR CAL knob, rotate the bare shaft until the average power displayed matches the number recorded above. Carefully install the knob with white-line indicator aligned to "10" on the panel. Without rotating the shaft, tighten the setscrews of the knob. When checking the knob, rotate the knob until the average power display matches the number recorded above, then check for knob indicator alignment to the "10" on the panel.

Return the DETECTOR CAL jumper to its normal position.

NOTE: Because the set screws dig into the shaft when installed, it is not possible to make small corrections to the knob after the first installation. The screws will locate themselves into their previous positions as they are tightened.

WARNING

DANGEROUS VOLTAGES ARE PRESENT IN THIS PRODUCT EVEN WHEN THE POWER SWITCH IS OFF. ONLY EXPERIENCED SERVICE PERSONNEL SHOULD ATTEMPT REPAIRS.

USE A LOW POWER SOLDERING IRON AND ROSIN CORE FLUX ONLY.

10.1 Disassembling The LDI-800

1. For Calibration: The LDI-800 is held together by four (4) screws on the bottom. Turn the instrument over on a soft surface and remove the four screws which pass through the feet. (The feet will also come off).

   Turn the instrument right-side-up on the soft surface. (The plastic enclosure consists of a top, bottom and two sides, with the top and bottom sandwiching the sides.) With the 4 screws removed, working carefully around the enclosure one corner at a time, gradually pull the top cover from the side rails. It will take several cycles around the corners to remove the top.

   After the top has been lifted off, all calibration may be performed without further disassembly.

2. For Further Service: After removing the top cover as described above, carefully lift the front board up out of its connector.

WARNING

DO NOT DISCONNECT THE WIRE FROM THE FRONT PANEL TO THE MAIN BOARD.

Remove the four (4) screws in the corners of the main board. Lay the front board on top of the main board. Grasp the main board and rock the rear panel slightly to ease it out of the groove in the plastic enclosure. Hold both ends of the main board and lift the assembly out of the plastic enclosure.

To remove the front board from the front panel remove the three (3) small knobs and the one (1) larger knob from their respective shafts. Remove the five (5) screws holding the front board to the front panel. Lift the board away from the panel.

WARNING

DO NOT DISCONNECT THE WIRE FROM THE FRONT PANEL TO THE MAIN BOARD.

10.2 Re-Assembly

Reassembly proceeds in the reverse order of disassembly. When placing the assembly in the enclosure ensure that the rear panel drops into the groove on both sides as it is lowered into the enclosure. When reassembling the front panel, install all screws loosely and position board for smooth button operation, then tighten the screws. Route the green safety wire so that it is not between the front board and the main board.

10.3 The Main Board (See Figure 10.1)

1. Jumpers (the main board has 6 jumpers):

   J6 Isolates (V+) power. Current through J6 with no laser connected and current limit at 0 should be about 10 mA.

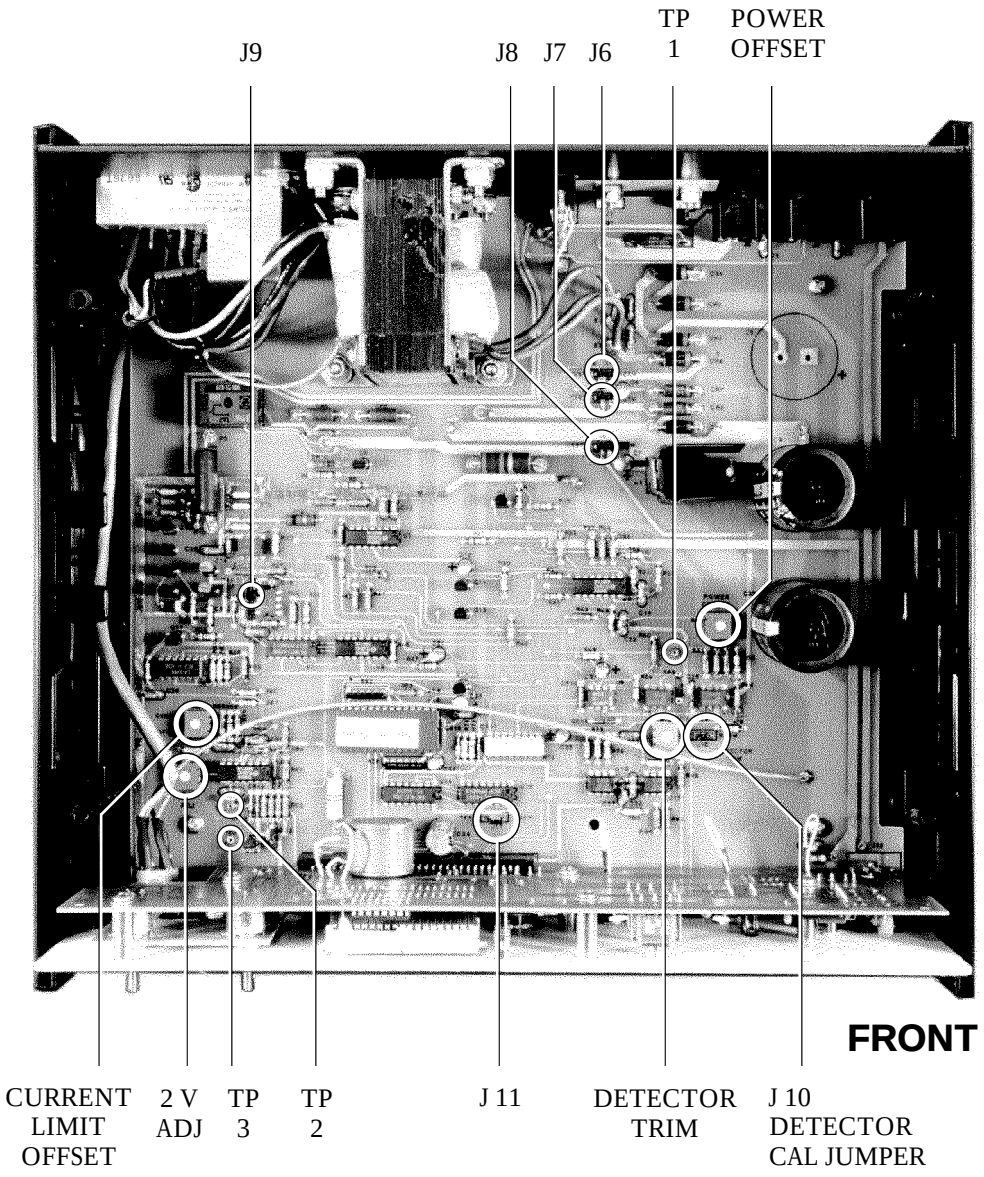
   J7 Isolates (V-) power. Current under same conditions above should be about 80 mA.

   J8 Isolates (5V) power. Current under same conditions above should be about 300 mA.

   J9 Isolates the current loop from the other feedback loops.

   J10 Supplies a substitute signal to the photodiode amplifier.

Figure 10.1 Main Board Assembly

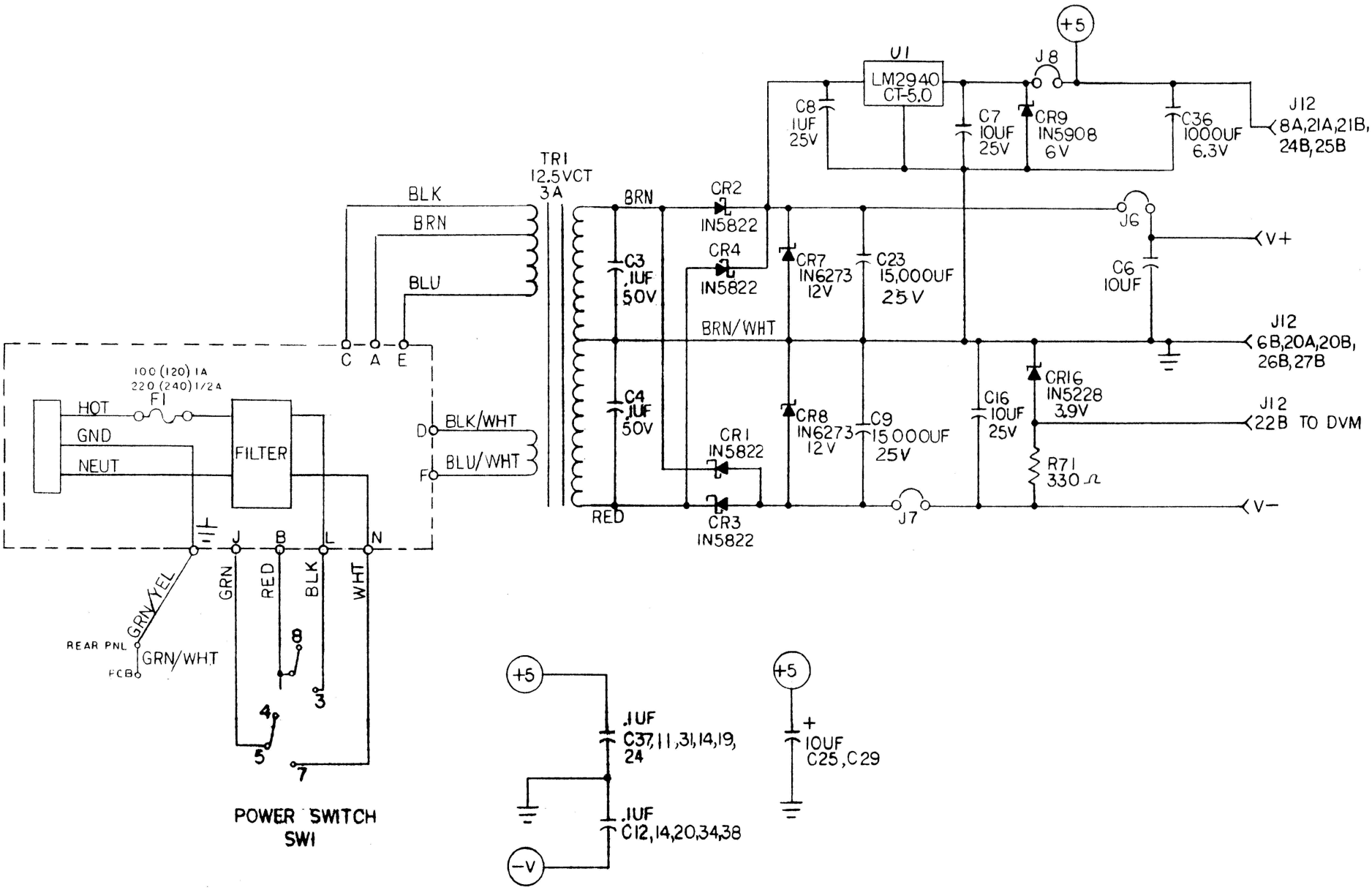


Section 11
Parts List

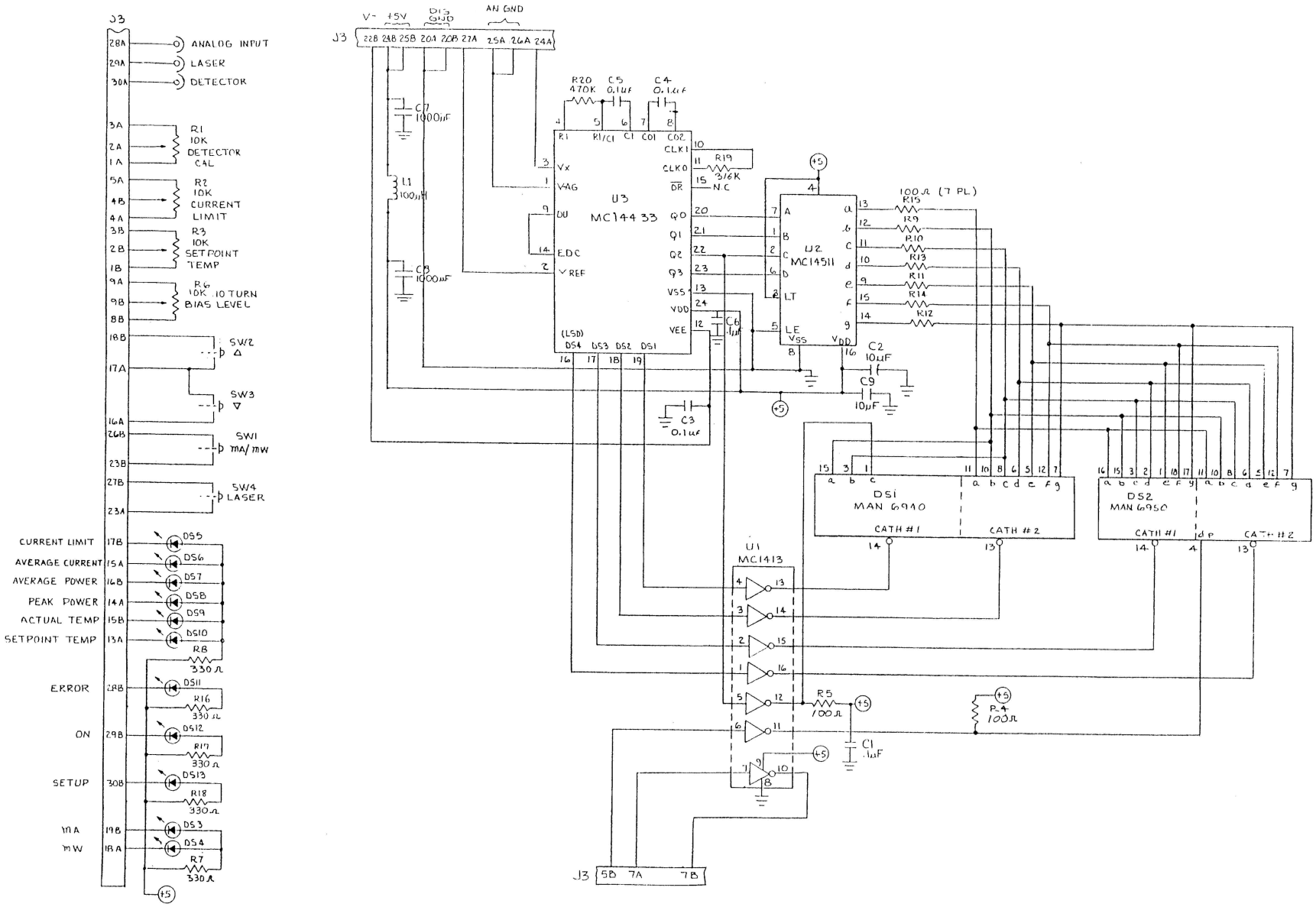
(A complete part list will be available at a later date.)

Section 12

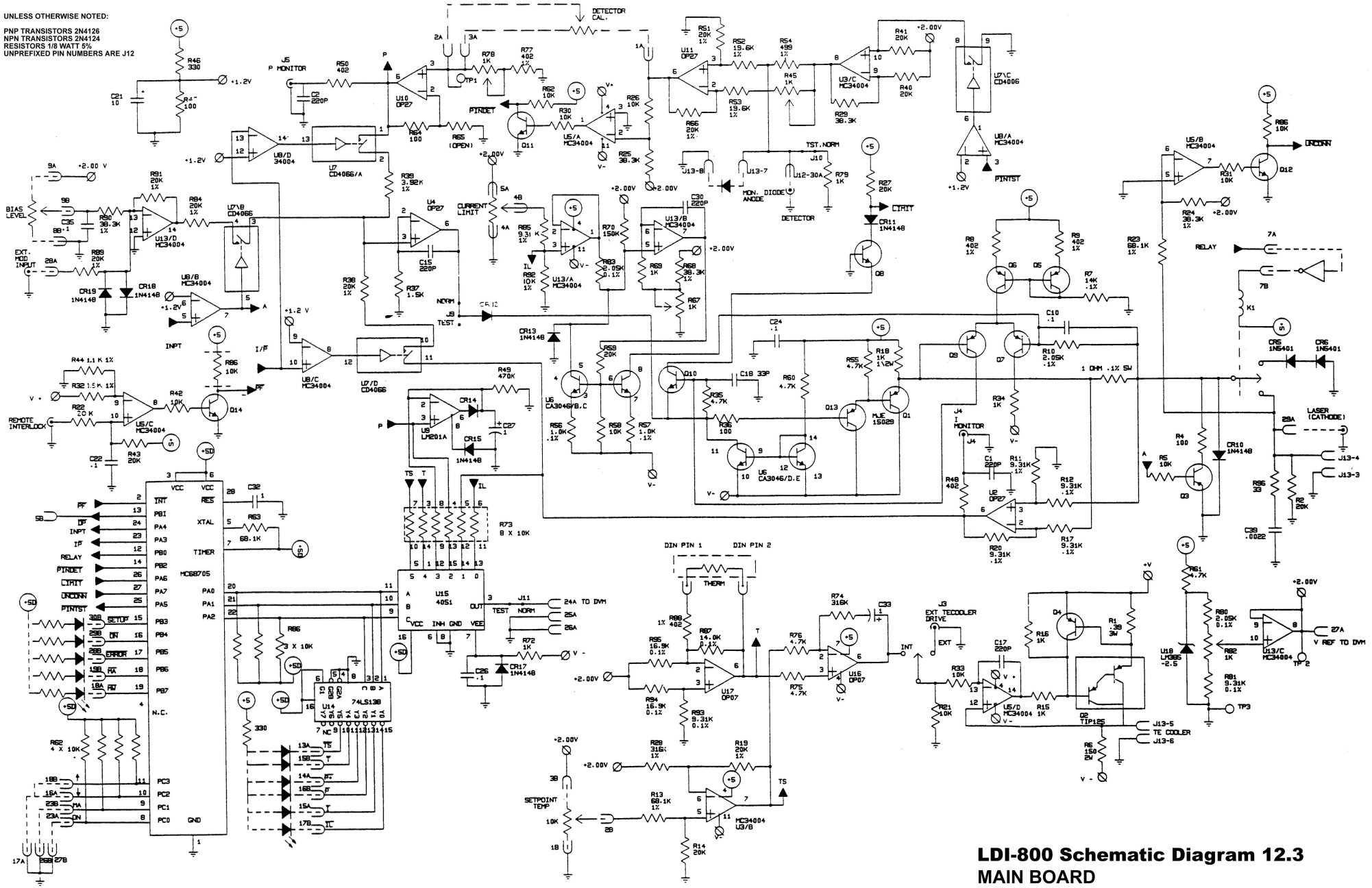
Schematic Diagrams



LDI-800 Schematic Diagram 12.1
POWER SUPPLY



LDI-800 Schematic Diagram 12.2
FRONT BOARD



LDI-800 Schematic Diagram 12.3

MAIN BOARD

12.4 Output Cable (Refer To Figure 5.1)

Wire Color	Function
Black	Thermistor Lead 1
Brown	Thermistor Lead 2
Red	Laser Anode (0 V)
Orange	Laser Cathode (negative)
Yellow	Thermoelectric Cooler Positive Lead (positive)
Green	Thermoelectric Cooler Negative Lead (0 V)
Blue	Monitor Photodiode Anode (negative)
Violet	Monitor Photodiode Cathode (0 V)

Comments in parentheses refer to the polarity of the voltage on a wire. The overall cable shield should be connected to the laser anode lead. The monitor photodiode shield should not be connected. (It is connected at the 8-pin connector.)

12.5 Driver Electronics:

Three schematics are shown for the LDI-800: the power supply, the front board and the main board. The actual power supply is located on the main board and rear panel.