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User's Guide

200 mA Current Source Module
CSM-39020

ILX Lightwave
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CSM-39020

200 mA Current Source Module

Instruction Manual

1.0 Introduction

The CSM-39020 200 mA Current Source is a precision current source module for use in the LDC-3900 Modular Laser Diode Controller. It may be installed in any of the four bays at the rear of the LDC-3900 (and may readily be interchanged with any other LDC-3900 module).

Features of the CSM-39020 include:

- Service-free modularity (calibration information is stored on the CSM-39020)
- Closed-case calibration
- High-stability, low noise design
- Flexible setup with LDC-3900 Save/Recall front panel functions
- Photodiode feedback control mode
- Modulation input

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2.0 CSM-39020 Specifications

Drive Current Output	
Output Current Range	0 - 200 mA
Setpoint Resolution	10 μA
Setpoint Accuracy	±0.1% of FS
Compliance Voltage	7V
Temperature Coefficient	<60 ppm / °C
Short-Term Stability (one hour)[2]	<20 ppm
Long-Term Stability (24 hours)[3]	<50 ppm
Noise and Ripple (μA / rms)[4]	
High Bandwidth Mode	<4 μA
Low Bandwidth Mode	<3 μA
With LNF-320[5]	<1 μA
Transients	
Operational[6]	<1 mA
Power Line Spike Induced[7]	<5 mA / <8 mA
Isolation	All modules isolated from other modules and earth ground
Drive Current Limit Settings	
Range	0 - 200 mA
Resultion	0.5 mA
Accuracy	±2 mA
Photodiode Feedback	
Type	Transimpedance
Reverse Bias	0-5V, adjustable
Photodiode Current Range	0-5 mA
Output Stability[8]	±0.02%
Setpoint Accuracy	±0.05% of FS
External Analog Modulation	
Input	0-10V, 10 kΩ
Transfer Function	20 mA/V
Bandwidth (3dB)	
High Bandwidth[9]	DC to 500 kHz
Low Bandwidth	DC to 5kHz
Low Bandwidth CW[5]	DC to 30 Hz

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Output Connectors	
Current Source Output	9-pin, D-sub
Photodiode Input	Coax BNC
Analog Modulation Input	Coax BNC, inst. amp. input
Measurement Display[10]	
Output Current Range	0 - 200 mA
Output Current Resolution	0.01 mA
Output Current Accuracy[11]	±0.05% of FS
Photodiode Current Range	0 - 5000 μA
PD Current Resolution	1 μA
PD Current Accuracy[11]	±0.05% of FS
PD Responsivity Range[12]	0.00 - 600.00 μA / mW
PD Responsivity Resolution	0.01 μA / mW
Optical Power Range	0.00 - 200.0 mW
Optical Power Resolution	0.01 mW
Forward Voltage Range	0.000 - 7.000V
Forward Voltage Resolution	1 mV
Forward Voltage Accuracy[13]	±5 mV

1. All values relate to a one-hour warm-up period.
2. Over any one-hour period, half-scale output at 25°C ambient.
3. Over any 24-hour period, half-scale output at 25°C ambient.
4. Measured optically from resulting intensity fluctuations of a laser diode with a 150kHz bandwidth photodetector. Measurements made with 1MHz detector are typically 10% higher.
5. With model LNF-320 low noise CW filter enabled.
6. Maximum output current transient resulting from normal operational situations (i.e., power on-off, current on-off), as well as accidental situations (i.e., power line plug removal). For more information, request ILX "Transient Test Standards" #LDC-00196.
7. Maximum output current transient resulting from a 1000V power line transient spike. Tested to ILX Lightwave Technical Standard #LDC-00196.
8. Maximum monitor photodiode current drift over any 30 minute period. Assumes zero drift in responsivity of photodiode.
9. 50% modulation at mid-scale output.
10. Displayed on LDC-3900 mainframe front panel "LASER" section.
11. Measured at 25°C.
12. Responsivity value is user-defined and is used to calculate the optical power.
13. Voltage measurement accuracy while driving calibration load. Connected at the rear panel connector. Accuracy may vary depending on load and cable length used.

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3.0 Installation

This section describes the procedures for installing and removing a CSM-39020 module from the LDC-3900.

> **NOTE - The LDC-3900 will power-up in a default state upon detecting any change in the LDC-3900 system configuration (such as installing a new module). All parameters and SAVE/RECALL settings will be set to default values, based on the new configuration. Calibration data is stored in the CSM-39020 module itself, and is never lost due to reconfiguration of the LDC-3900.**

To install the CSM-39020 module into the LDC-3900, follow these steps:

1. **Turn the LDC-3900 power off**.

2. Place the CSM-39020 module into an open bay on the back of the LDC-3900 and slide the module into place. There are tracks at the top and bottom of the bay which guide the module into place. Push the module into place until the board edge clicks into place with an audible "pop." This indicates that the module is "locked" into place. Screw the Module Locking Screws into the back panel to secure the module. It is then ready to be used in the LDC-3900.

3. Power-up the LDC-3900.

4. After the LDC-3900 has completed its power-up sequence, the (ADJUST) LAS indicator which corresponds to the newly installed CSM-39020 module should be lit in green, indicating that the module has been recognized as a LASER current source in its respective bay.

To remove the CSM-39020 module from the LDC-3900, follow these steps:

1. **Turn the LDC-3900 power off**.

2. Unscrew the Module Locking Screws which secure the module to the LDC-3900 back panel.

3. Grasp the CSM-39020 module by handle which extends from the bottom of the back panel. Gently, but firmly, pull the module out of the LDC-3900.

4. If the CSM-39020 module is replaced in the LDC-3900 before the LDC-3900 is powered up again, the LDC-3900 will retain its memory of all parameter settings and SAVE/RECALL values. However, if the LDC-3900 is powered up and detects a change in its system configuration, all parameters and SAVE/RECALL information will be lost. Calibration data is stored in the CSM-39020 module itself, and is never lost due to reconfiguration of the LDC-3900.

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4.0 Operation

This section describes the procedures for connecting and running a laser diode with the CSM-39020 module. Refer to Chapter 2 of the LDC-3900 Instruction Manual for front panel description and operation.

Refer to Figure 4.1 for the following discussion of connections to the CSM-39020.

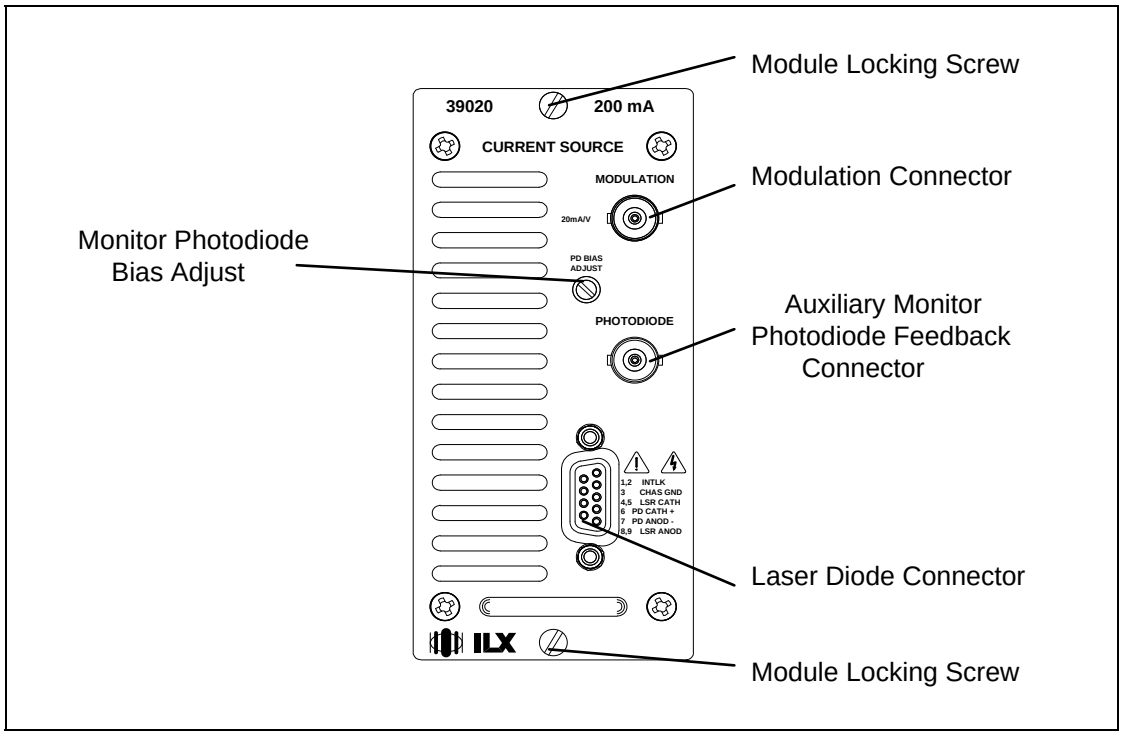


Figure 4.1 CSM-39020 Back Panel

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4.1 The LASER Connector

On the back panel of the CSM-39020 you will find a 9-pin D-connector for the LD connections. The pinout diagram for this connector is shown in Figure 4.2.

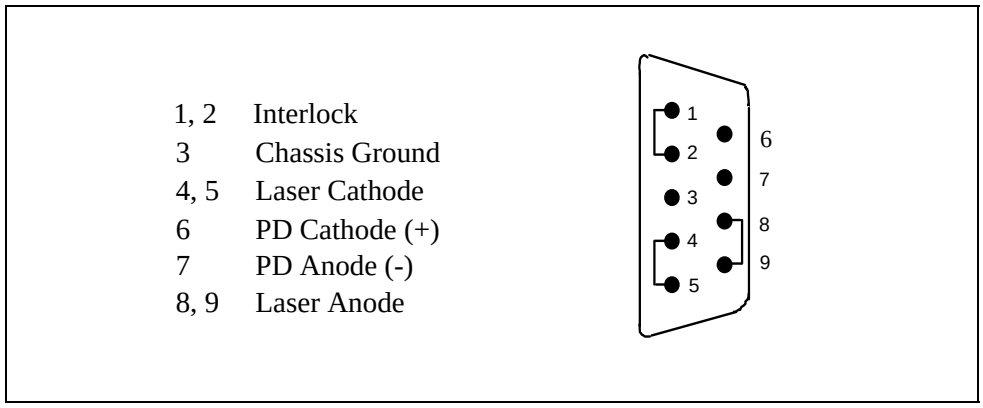


Figure 4.2 Back Panel LD Connector

4.2 Connecting to Your Laser

When connecting laser diodes and other sensitive devices to the CSM-39020, we recommend that the LDC-3900 be powered up and the LASER output be off (LASER MODE ON LED unlit). In this condition, a low impedance shunt is active across the output terminals. When disconnecting devices, it is only necessary to turn the LASER Output off.

4.3 Laser Diode Connections and Shielding

IMPORTANT

Before connecting the laser diode to the LDC-3900 Modular Laser Diode Controller, be sure that the front panel (LASER MODE) ON switch is in the OFF position (ON LED unlit). Before turning on the LASER output, be sure that the current limit has been correctly set.

Figures 4.3 A - D show the possible configurations of connecting laser diodes and photodiodes with the LDC-3900 Modular Laser Diode Controller.

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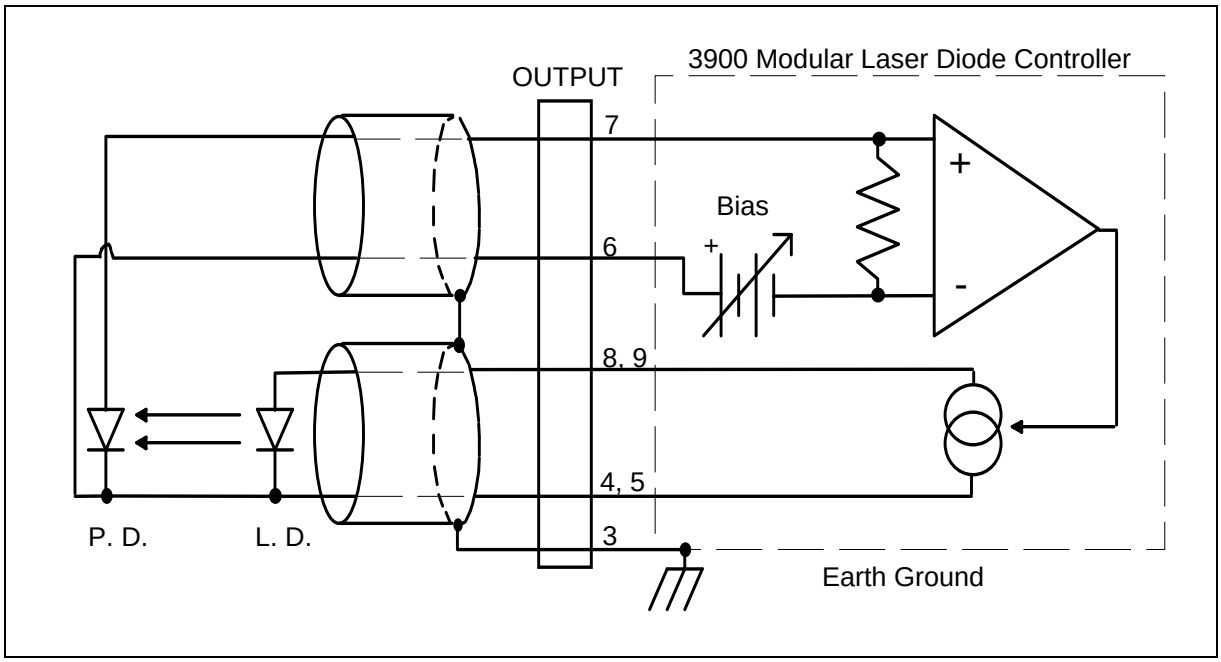


Figure 4.3A Common Laser Cathode - Photodiode Cathode

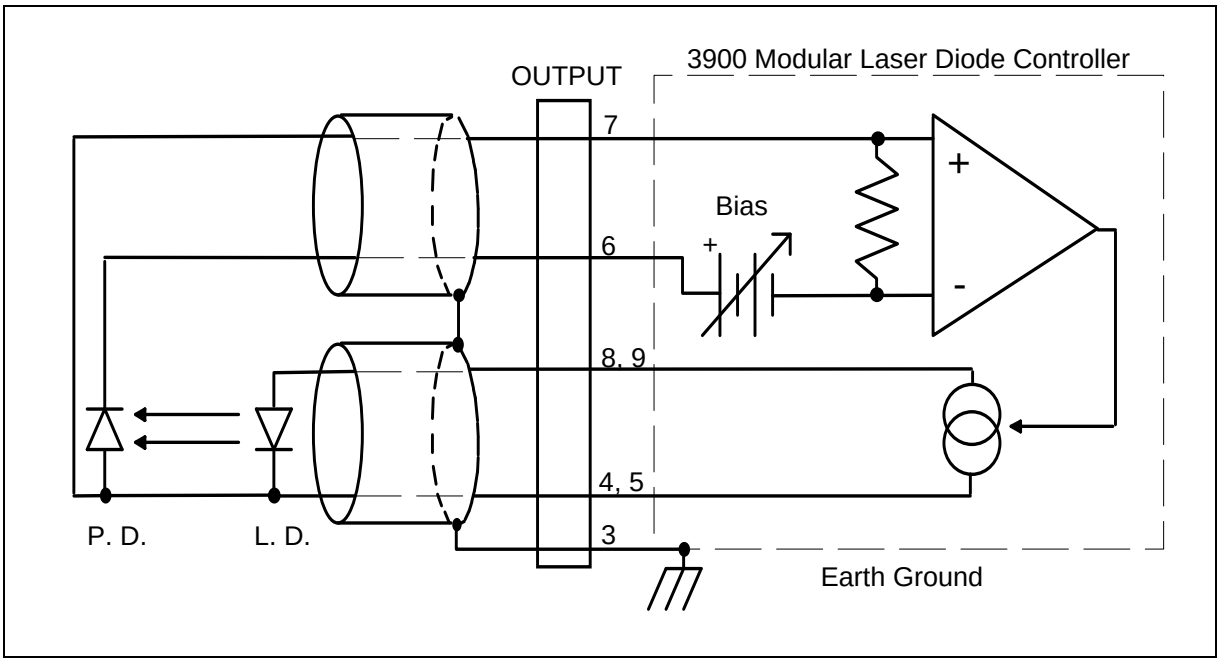


Figure 4.3B Common Laser Cathode - Photodiode Anode

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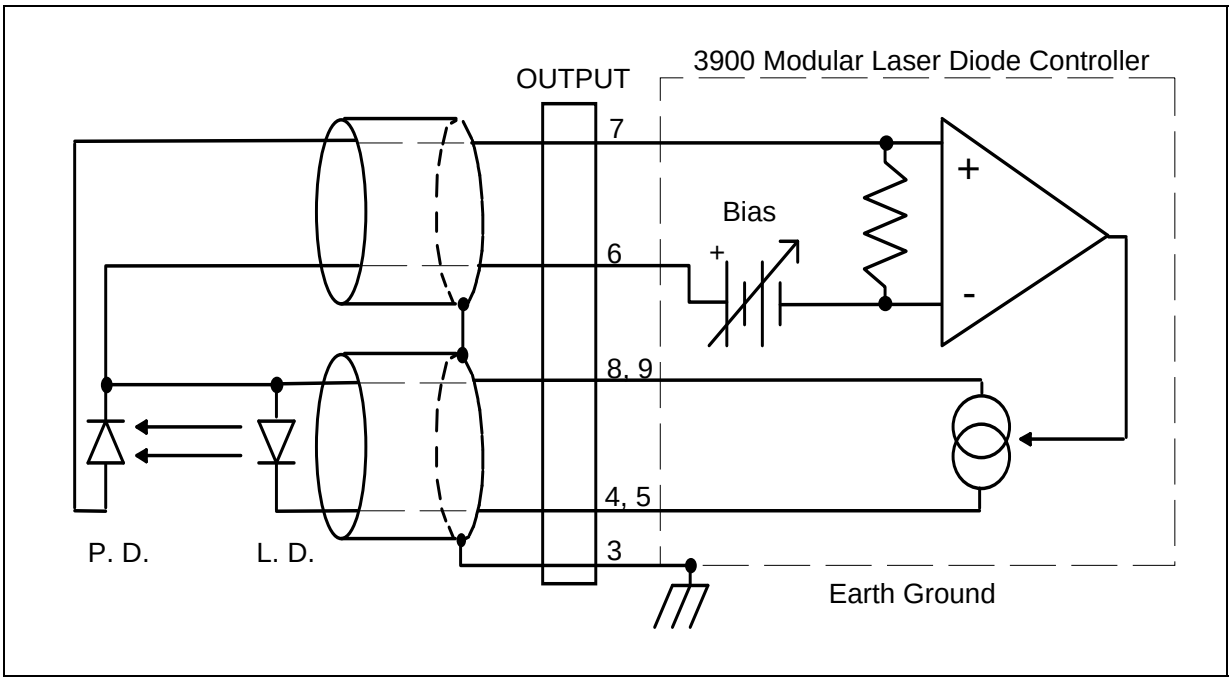


Figure 4.3C Common Laser Anode - Photodiode Cathode

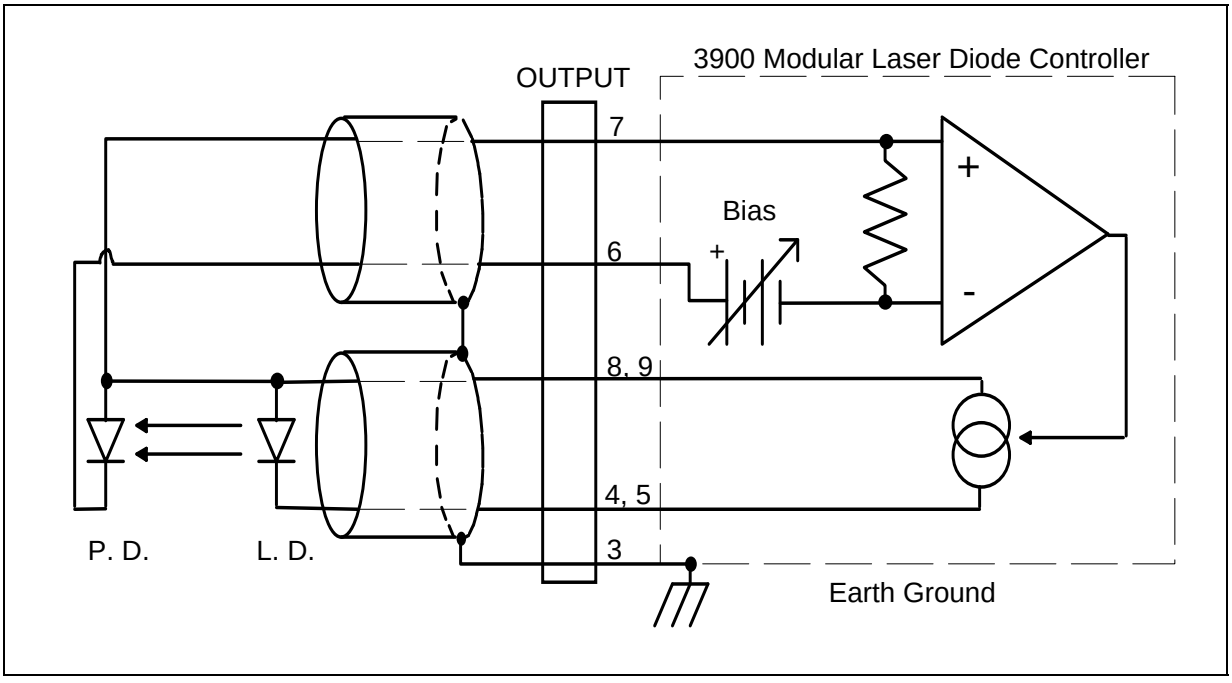


Figure 4.3D Common Laser Anode - Photodiode Anode

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IMPORTANT

The cable connections to the laser must be secure enough that they won't open-circuit, should they be jostled or bumped. Should an open circuit occur during laser operation, the LASER output will be turned off (OUTPUT LED unlit) automatically.

Experience indicates that should an open circuit occur during laser operation (while the LASER is ON), the laser may be damaged by a momentary circuit break-and-remake before the final circuit break. Therefore, although the CSM-39020 provides a proprietary debounce protection circuit for the LASER output, secure cabling is important.

It is recommended that the connections to the CSM-39020 output be made using twisted wire pairs with an earth-grounded shield (see Figures 4.3 A - D). The output terminals of the unit are left floating relative to earth ground to suppress AC power-on/power-off transients that may occur through an earth-ground path. If the output circuit is earth-grounded at some point (such as through the laser package and mount), the user must be careful to avoid multiple earth grounds in the circuit. Multiple earth grounds may provide circuit paths that induce spurious currents in the photodiode feedback circuit and output leads.

4.4 Photodiode Feedback Connections

The connector on the back panel of the CSM-39020 contains the current supply output. The photodiode signal is input at the connector at pins 6 and 7 (see Figure 4.2). The CSM-39020 provides an adjustable reverse bias of 0 - 5 V for the photodiode. To set the photodiode bias to 5 volts reverse bias, turn the back panel PHOTODIODE BIAS ADJUST fully clockwise. To set the photodiode bias to 0 volts reverse bias, turn the back panel PHOTODIODE BIAS ADJUST fully counter-clockwise.

The photodiode feedback may also be connected via the PHOTODIODE (BNC) connector, located on the CSM-39020 back panel.

Many laser diode modules contain an internal photodiode that monitors the back-facet emission of the laser. Usually, this photodiode is internally connected to either the laser anode or cathode. Figures 4.2A - 4.2D show the recommended connections and shielding for the various configurations of laser diode modules and photodiode feedback schemes.

The photodiode and laser inputs on the CSM-39020 are electrically isolated from ground and each other. So, if a 4-pin connection is made (no common connections) no additional jumpers are required. Figures 4.2A - 4.2D show the recommended connections and shielding for 3-pin lasers (where the common connection is internal to the device). A 4-pin laser should be connected with the same shielding as shown in Figure 4.2, but the common connection (between the photodiode and the laser) is optional.

4.5 Grounding Considerations

The LASER outputs of the CSM-39020 are isolated from chassis ground allowing either output terminal to be grounded at the user's option. Figure 4.3 shows the proper earth-ground shielding for laser diode/photodiode connections.

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4.6 Modulation Connections

The MODULATION connector allows a 20 mV/A modulation signal to be applied to the laser. The modulation port input impedance is 10 kΩ.

5.0 Calibration

The CSM-39020 should be calibrated every 12 months or whenever performance verification indicates that calibration is necessary.

All calibrations can be done with the case closed. The instrument is calibrated by changing the internally stored digital calibration constants.

5.1 Recommended Equipment

Recommended test equipment for calibrating the CSM-39020 is listed in Table 5.1. Equipment other than that shown in the table may be used if the specifications meet or exceed those listed. If your LDC-3900 is equipped with the model 1231 GPIB/IEEE-488.2 interface you may refer to sections 5.4.2, 5.4.4 and 5.4.6 for calibration procedures using the GPIB, if desired.

RECOMMENDED TEST EQUIPMENT

Description	Mfg./Model	Specification
DMM	HP 3457A	0.1 μA or 0.1 mV resolution
Resistor		49 Ω, 5 W, low TCR, for voltage cal.
I_{PD} Calibration		
Resistors	Metal Film	49 Ω, and 100 Ω, 1%, 1/4 W
	High-power	10 Ω, 5 W, low TCR
Optical Isolator	TIL117	or equivalent, 6-pin
Connector	D-sub	9-pin male

Table 5.1 Recommended Test Equipment

5.2 Environmental Conditions

Calibrate this instrument under laboratory conditions. We recommend calibration at 23°C ± 1.0°C. When necessary, however, the CSM-39020 may be calibrated at its intended use temperature if this is within the specified operating temperature range of 0 to 50°C.

5.3 Warm-Up

The LDC-CSM-39020 should be allowed to warm up for at least 1 hour before calibration.

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5.4 LASER Controller Calibration Procedures

There are three calibration procedures that need to be made for the CSM-39020. They are calibration of the constant current source (for both bandwidths), calibration of the laser voltage measurement, and calibration of the constant light power (I_{PD}) feedback circuits.

The CSM-39020 implements a two-point calibration for the Laser current source. Two currents are applied to a load, and the resulting measured currents are fed back (by the user) to the CSM-39020. The CSM-39020 calibration program uses the two data points to calculate calibration constants that it will thereafter use to set current.

If you have the optional Model 1231 IEEE-488.2/GPIB interface you may follow the procedure in sections 5.4.2, 5.4.4, and 5.4.6 to calibrate the CSM-39020 remotely.

5.4.1 Local Operation Current Source Calibration

The following procedure is for local (front panel) operation. See Section 5.4.2 for remote calibration of the current source.

a. Select the CSM-39020 to be calibrated by pressing the appropriate (ADJUST) switch. Set the LASER current limit (LIM I) to full scale, bandwidth as desired, and current set point to 160 mA (80% of full scale). Connect a calibrated DMM to measure the current across the output (pins 5 and 8).

b. Turn the (LASER ENABLE) ON switch and press the appropriate OUTPUT switch to turn the LASER output on. If the LASER output is not on, the LASER I calibration mode cannot be entered. If the LASER output is on, but the LASER channel is not selected (see Step a), calibration will be performed improperly.

c. Enter the LASER I calibration mode by pushing the (GPIB) LOCAL and (LASER DISPLAY) I switches at the same time. The LASER display will indicate output current in mA. The LDC-3900 will beep when it is ready to accept a new calibration value.

d. Press and hold in the (PARAMETER) SET switch and turn the ADJUST knob until the LASER display indicates the same current as measured via the DMM.

e. Release the (PARAMETER) SET switch to accept the first calibration value. After the (LASER DISPLAY) SET switch is released, the LDC-3900 will beep. It will then apply the second calibration current, approximately one-fourth of the original current.

f. The LDC-3900 will beep when it is ready to accept the second calibration value. When it does, press and hold in the (PARAMETER) SET switch and turn the ADJUST knob until the LASER display indicates the same current as measured via the DMM.

g. Release the (PARAMETER) SET switch to accept the second calibration value. After the (PARAMETER) SET switch is released, the LDC-3900 will calculate the calibration constants, store them to nonvolatile memory on the CSM-39020, beep, and return to its former (before calibration) state.

h. Repeat this procedure with the other bandwidth, if desired.

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5.4.2 Remote Operation Current Source Calibration

The following procedure is for remote (GPIB) operation. See Section 5.4.1 for local calibration of the current source.

a. Select the CSM-39020 to be calibrated by sending the "LAS:CHAN x" command, where x is the channel of the CSM-39020. Set the LASER limit to full scale via the "LAS:LIM:I 200" command, output bandwidth as desired via the "LAS:MODE" command, and current set point to 80% of full scale via the "LAS:LDI 160" command. Connect a calibrated DMM to measure the current across the laser output (pins 5 and 8).

b. Turn the (LASER ENABLE) ON switch. Enter the "LAS:OUT ON" command to turn the LASER output on. If the LASER output is not on, the LASER I calibration mode cannot be entered.

c. Enter the LASER I calibration mode by issuing the "LAS:CAL:LDI" command. The LDC-3900 will beep when it is ready to accept the first calibration point.

d. Input the first actual (measured) LASER output current (as an <nrf value>) via the "LAS:LDI <nrf value>" command.

   If this value is to be measured and entered remotely via a GPIB controlled DMM, for example, the measured value of the current should not be entered until the LDC-3900 is ready to receive it.

   The LDC-3900 will be ready to receive the current value when, after a "LAS:CAL:LDI?" query is sent, the response from the LDC-3900 is "1".

e. Once the actual I value is entered via the "LAS:LDI" command, the LDC-3900 will beep and will apply a new current equal to approximately one-fourth (1/4) the previous set current. The LDC-3900 will be ready to receive the second current value when, after a "LAS:CAL:LDI?" query is sent, the response from the LDC-3900 is "1".

f. Input the second actual (measured) LASER output current (as an <nrf value>) as in Step d.

g. Once the second actual I value is entered via the "LAS:LDI" command, the LDC-3900 will beep and the new calibration constants will be calculated and stored into non-volatile memory on the CSM-39020. The "OPC?" query may be used (after the "LAS:LDI" value is sent) to determine when the calibration is completed.

   The operation complete flag (bit 0 of the Standard Event Status Register) may be used to trigger a service request. This type of interrupt is enabled by setting bit 0 of the Service Request Enable register (via the *ESE command) and bit 5 of the Service Request Enable register (via the *SRE command). Service request (SRQ) handling depends on your GPIB hardware. Refer to your GPIB user's manual for details.

h. Repeat this procedure with the other range, if desired.

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5.4.3 Local Operation I_{PD} Current Calibration

The following procedure is for calibrating the LASER I_{PD} constant current source. This procedure calibrates the feedback circuits for constant I_{PD} and constant P_{PD} modes. When these values are reached and are stable, the user enters the actual value of the current, as measured by an external DMM. The CSM-39020 then automatically calibrates the LASER feedback circuits.

This procedure is for local (front panel) operation. See Section 5.4.4 for remote calibration of the I_{PD} current.

a. Select the CSM-39020 to be calibrated by pressing the appropriate (ADJUST) switch. With the LASER output off, connect a calibrated ammeter to the PD Anode output of the CSM-39020, and connect the circuit of Figure 5.1 to the LASER and PD outputs.

   If a calibrated ammeter (with 0.1 μA resolution) is not available, place a calibrated DMM (with 0.1 mV resolution) to measure the voltage across the resistor, R1, as shown in Figure 6.1. Calculate the current in the following steps by using Ohm's Law:

   $$I = E / R$$

   -where E is the accurately measured voltage across the resistor, and R is the accurately measured load resistance. (A 4-point probe resistance measurement is recommended.)

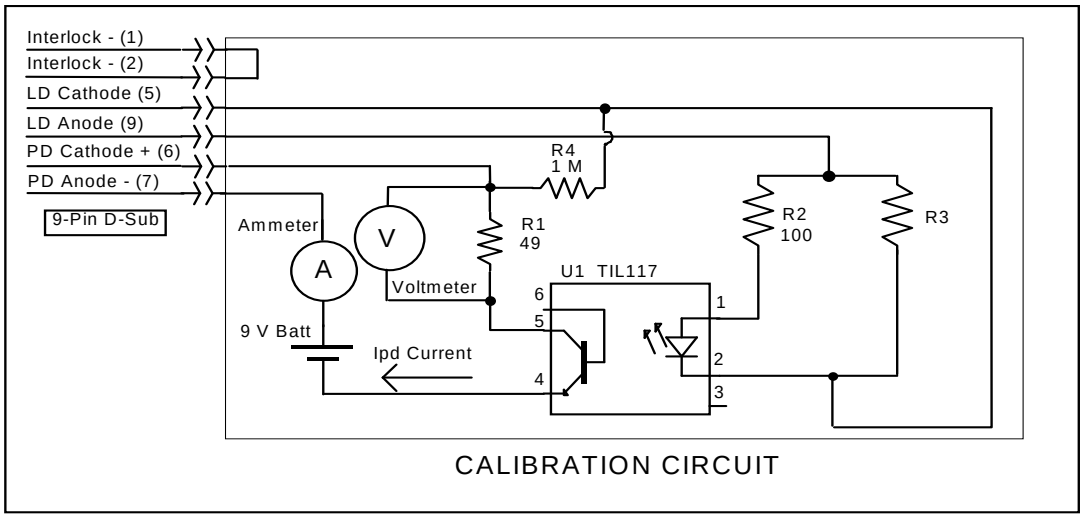


Figure 5.1 I_{PD} Calibration Circuit

b. Set the LASER current limit (LIM I) to 200 mA. Set the I_{PD} set point to 4000 μA, and set the CAL PD parameter to zero. This puts the CSM-39020 into a constant I_{PD} mode.

c. Turn the (LASER ENABLE) ON switch and press the appropriate OUTPUT switch to turn the LASER output on. If the LASER output is not on, the LASER I_{PD} calibration mode cannot be entered.

d. Press the (GPIB) LOCAL and (LASER DISPLAY) I_{PD}/P_{PD} switches at the same time to place the CSM-39020 in its LASER I_{PD} Calibration mode.

   After a few seconds the LDC-3900 will beep and the LASER display will show the I_{PD} set point value.

e. After the value on the LASER display is stable (has not changed by more than one digit for several seconds) the CSM-39020 is ready for the actual I_{PD} value to be entered.

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Press and hold in the (PARAMETER) SET switch and turn the ADJUST knob until the LASER display shows the correct value, as shown on the calibrated ammeter (or the calculated I_{PD} value from Step a).

f. Release the (PARAMETER) SET switch to store the first calibration value into non-volatile memory. It will then expect the second calibration current current, approximately one-fourth of the original current.

g. The LDC-3900 will beep when it is ready to accept the second calibration value. When it does, press and hold in the (PARAMETER) SET switch and turn the ADJUST knob until the LASER display indicates the same current (as measured directly, or as calculated in Step a, from the measured voltage).

h. Release the (PARAMETER) SET switch to accept the second calibration point. After the (PARAMETER) SET switch is released, the LDC-3900 will calculate the calibration constants, store them to nonvolatile memory on the CSM-39020, beep, and return to its former (before calibration) state.

5.4.4 Remote Operation I_{PD} Current Calibration

The following procedure is for calibrating the LASER I_{PD} constant current source over GPIB. This procedure calibrates the feedback circuits for constant I_{PD} and constant P_{PD} modes. When these values are reached and are stable, the user enters the actual value of the current, as measured by an external DMM. The CSM-39020 then automatically calibrates the LASER feedback circuits.

This procedure is for remote (GPIB) operation. See Section 5.4.3 for local calibration of the I_{PD} current.

a. With the LASER output off, connect a calibrated ammeter to the PD Anode output of the CSM-39020, and connect the circuit of Figure 5.1 to the LASER and PD outputs.

   If a calibrated ammeter (with 0.1 μA resolution) is not available, place a calibrated DMM (with 0.1 mV resolution) to measure the voltage across the resistor, R1, as shown in Figure 5.1. Calculate the current in the following steps by using Ohm's Law:

   $$I = E / R$$

   -where E is the accurately measured voltage across the resistor, and R is the accurately measured load resistance. (A 4-point probe resistance measurement is recommended.)

b. Select the CSM-39020 to be calibrated by sending the "LAS:CHAN x" command, where x is the channel of the CSM-39020. Set the LASER current limit via the "LAS:LIM:I 200" command. Set the I_{PD} set point to 4000 μA via the "LAS:MDI 4000" command. Set the CAL PD parameter to zero via the "LAS:CALMD 0" command. This puts the CSM-39020 into a constant I_{PD} (MDI) mode.

c. Turn the (LASER ENABLE) ON switch. Enter the "LAS:OUT ON" command to turn the LASER output on. If the LASER output is not on, the LASER I_{PD} calibration mode cannot be entered.

d. Enter the "LAS:CAL:MDI" command to place the CSM-39020 in its LASER I_{PD} Calibration mode.

e. After a few seconds, the LDC-3900 will be ready for the actual I_{PD} current to be entered via the "LAS:MDI" command. The measured value of the current should not be entered until the LDC-3900 is ready to receive it. The LDC-3900 will beep when it is ready to accept a new calibration value.

   The LDC-3900 will be ready to receive the I_{PD} value when, after a "LAS:CAL:MDI?" query is sent, the response from the LDC-3900 is "1".

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f. Once the actual I value is entered via the "LAS:MDI" command, the LDC-3900 will beep and the new calibration value will be stored into non-volatile memory. It will then set the current to approximately one-fourth of the original current and expect the second calibration value to be entered. The LDC-3900 will be ready to receive the second I_{PD} value when, after a "LAS:CAL:MDI?" query is sent, the response from the LDC-3900 is "1".

g. Input the second actual (measured) I_{PD} current (as an <nrf value>) as in Step e.

h. Once the second actual monitor diode current value is entered via the "LAS:MDI" command, the LDC-3900 will beep and the new calibration constants will be calculated and stored into non-volatile memory in the CSM-3900. The "OPC?" query may be used (after the "LAS:MDI" value is sent) to determine when the calibration is completed.

   The operation complete flag (bit 0 of the Standard Event Status Register) may be used to trigger a service request. This type of interrupt is enabled by setting bit 0 of the Service Request Enable register (via the *ESE command) and bit 5 of the Service Request Enable register (via the *SRE command). Service request (SRQ) handling depends on your GPIB hardware. Refer to your GPIB user's manual for details.

5.4.5 Local Operation Laser Voltage Measurement Calibration

The following procedure is for calibrating the LASER voltage measurement via the front panel. See Section 5.4.5 for remote (GPIB) calibration of the voltage measurement.

a. With the LASER output off, connect a calibrated voltmeter, in parallel with a 49 Ω, 5 Watt, low temperature coefficient resistor, to the LASER output of the CSM-39020 (pins 5 and 8).

b. Select the CSM-39020 to be calibrated by pressing the appropriate (ADJUST) switch. Set the LASER current limit (LIM I) to 200 mA. Set the LASER I set point to 120 mA.

c. Turn the (LASER ENABLE) ON switch and press the appropriate OUTPUT switch to turn the LASER output on. If the LASER output is not on, the LASER voltage calibration mode cannot be entered.

d. Press the (GPIB) LOCAL and (LASER DISPLAY) V switches at the same time to place the CSM-39020 in its LASER Voltage Calibration mode.

e. After a few seconds, the LDC-3900 will beep when it is ready to accept a new calibration value. Press and hold in the (PARAMETER) SET switch and turn the ADJUST knob to enter the LASER voltage measurement value which appears on the DMM. Release the (PARAMETER) SET switch to enter the value.

   Once the actual voltage value is entered, the LDC-3900 will beep. It will then set the output to approximately one-fourth of the original voltage, and then it will expect the second calibration voltage point to be entered

f. Input the second actual (measured) LASER voltage (as an <nrf value>) as in Step e.

g. Once the second actual voltage value is entered, the LDC-3900 will beep and the new calibration constants will be calculated and stored into non-volatile memory on the CSM-39020.

5.4.6 Remote Operation Laser Voltage Measurement Calibration

The following procedure is for calibrating the LASER voltage measurement via GPIB. See Section 5.4.5 for local calibration of the voltage measurement.

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a. With the LASER output off, connect a calibrated voltmeter, in parallel with a 49 Ω, 5 Watt, low temperature coefficient resistor, to the LASER output of the CSM-39020 (pins 5 and 8).

b. Select the CSM-39020 to be calibrated by sending the appropriate "LAS:CHAN x" command, where x is the channel number of the CSM-39020. Set the LASER current limit via the "LAS:LIM:I 200". Set the I set point via the "LAS:LDI 120" command.

c. Turn the (LASER ENABLE) ON switch. Enter the "LAS:OUT ON" command to turn the LASER output on. If the LASER output is not on, the LASER voltage calibration mode cannot be entered.

d. Enter the "LAS:CAL:LDV" command to place the CSM-39020 in its LASER Voltage Calibration mode.

e. After a few seconds, the LDC-3900 will be ready for the actual laser voltage to be entered via the "LAS:LDV" command. The measured value of the voltage should not be entered until the LDC-3900 is ready to receive it.

   The LDC-3900 will be ready to receive the voltage value when, after a "LAS:CAL:LDV?" query is sent, the response from the LDC-3900 is "1".

f. Once the actual voltage value is entered via the "LAS:LDV" command, the LDC-3900 will beep. It will then expect the second calibration voltage point, approximately one-fourth of the original voltage. The LDC-3900 will be ready to receive the second voltage value when, after a "LAS:CAL:LDV?" query is sent, the response from the LDC-3900 is "1".

g. Input the second actual (measured) LASER voltage (as an <nrf value>) as in Step e.

h. Once the second actual voltage value is entered via the "LAS:LDV" command, the LDC-3900 will beep and the new calibration constants will be calculated and stored into non-volatile memory on the CSM-39020.

   The operation complete flag (bit 0 of the Standard Event Status Register) may be used to trigger a service request. This type of interrupt is enabled by setting bit 0 of the Service Request Enable register (via the *ESE command) and bit 5 of the Service Request Enable register (via the *SRE command). Service request (SRQ) handling depends on your GPIB hardware. Refer to your GPIB user's manual for details.

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