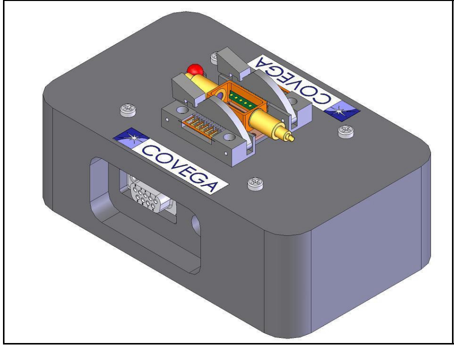
Laser Diode Controller 1300 Driver

Operating Manual

Version 1.2



LDC 1300 Operating Manual

1. Introduction

The Laser Diode Controller (LDC 1300) system is based around a small-form-factor current source and thermo-electric controller (the LDR unit) designed to drive laser diodes, SOA's, SLED's, etc. For complete functionality the LDR drive board must be integrated with an interface board for PC control, while a range of direct mounting device boards for industry standard butterfly and DIL packages are available. The interface board (the LDC family) incorporates a power inlet and a RS232 interface to allow computer control. If required, the interface board is designed to accommodate a photodiode for power monitoring and automatic power control. As an alternative to the small-form-factor design, a Eurocard size board is also available to interface with the LDR unit and combines the computer control interface with flexible device mounting options through the use of user configured wire jumpers.

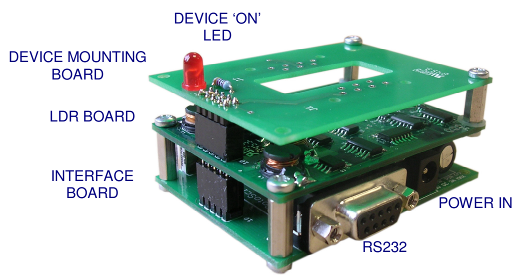


Figure 1: The basic LDC stack

2. System design

The LDC drive board is designed to deliver source current up to 1A and is capable of supplying TEC currents of 2.5A. This is achieved in the 85x140 mm form factor through the use of a high efficiency switched mode design, typically delivering 85-90% efficiency and eliminating the need for heat sinking of the drive electronics.

The accompanying LDC software provides complete computer control of the LDC system. (It should be noted that the screen size of the LDC software is fixed and cannot be resized). Any updates to the LDC software can be downloaded from the COVEGA web site.

3. Operating Procedures

These operating procedures apply to the LDC board.

3.1.1 Mounting the Device

The device is mounted on the LDC board using the orientation shown in Figure 2. The output of the device is oriented towards the LED on the LDC board.

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3.1.2 Connecting Power

Before connecting power to the unit ensure that the serial cable is also attached. The RS232

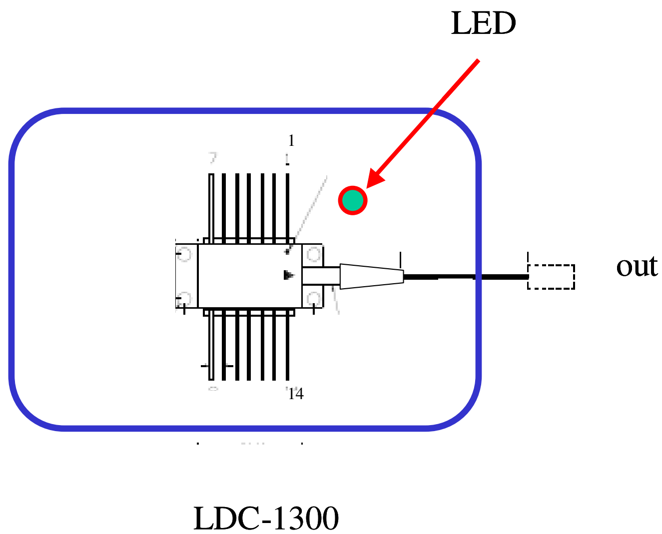

Figure 2. Mounting orientation of the device under test on the LDC board

connection is made with a standard serial cable (i.e. all pins connected straight through - *not* a null modem).

A regulated 5V DC power supply with a minimum current rating of 2.4A is required. If using a bench power supply it is recommended to power up at the operating voltage rather than ramping the voltage up slowly. The permissible input voltage range is 4.5 to 5.5V. Power is supplied via a standard 2.1mm diameter jack with the centre positive (e.g. Digikey part no. SC1052-ND, Farnell 224-923).

WARNING: Always disconnect power from the board before inserting or removing a laser or SOA. This will avoid the possibility of sending high transient currents through the device.

The LDC is supplied with the TEC controller adjusted for stable operation at 25°C; this assumes adequate heat sinking of the active device.

When power is connected to the LDC unit the temperature controller will start and attempt to stabilise the temperature of any device that is connected. However, if the temperature fails to stabilise after approximately 10 seconds the driver is designed to revert to safety shutdown mode, a full description is given in section 3.2.2. The power must be either be cycled (off-on) or the Reset Protection button (under Functions TEC Controller Setup) used to reset it. You may wish to check the settings of the LDR (TEC set point, PID settings) before connecting a device if you have any doubts over the operating parameters.

3.1.3 The PC Interface

Ensure that the LDC software is installed, running correctly and a suitable cable has been used to connect the PC serial output to the LDRI interface board. Figure 3**Error! Reference source not found.** shows the layout of the main LDC window. The screen in divided into six main panels: ℵ

Communications, ℑ Connection Status, ℜ Main Chart Display, ℘ Instantaneous Measurements, ⊗ TEC Drive and ⊕ Current Source.

The communications interface is established between the PC and LDC module by selecting the appropriate COM port and pressing the CONNECT button in the Communications panel (Figure 3**Error! Reference source not found.** & Figure 4**Error! Reference source not found.**). When connection is established panel ℑ should report that it has read Board and Data information and that all is OK.

When connected, the main LDC screen continually updates the device parameters. The instantaneous measurements are displayed in the right hand panel ℘ and a rolling chart of the active measurements is displayed in the main area ℜ. Each measurement can be toggled on/off by using the check boxes in panel ℘.

Figure 3: *Full screen shot of the LDC 2.2.1 software*

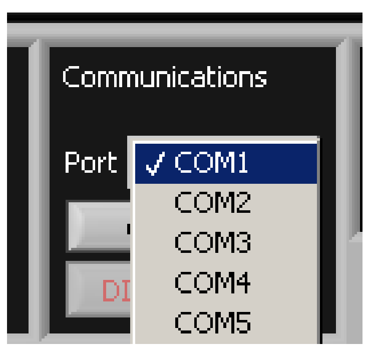

Figure 4: *Select the COM port and press Connect to establish the PC to LDC connection*

In the main chart display panel the user can re-scale the graphs by clicking on the maximum (or minimum) setting, then deleting the current value and typing in a new limit.

To close the LDC software, click on the *QUIT* button in the lower right hand corner of the screen (panel ℑ), and then confirm to *"really quit".*

3.2 TEC Controller

With a device installed, and appropriate steps taken to connect power and establish the link with the software, the LDC main panel will immediately show the device temperature being monitored. The device set point is changed by either typing the desired value directly into the *Set Temperature* box, (TEC Driver panel), or by using the up/down arrows to change the temperature in 0.1°C steps.

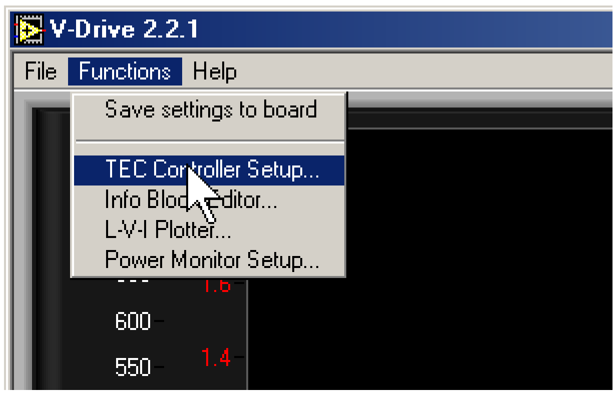

Figure 5: *TEC Tuner is found under the Functions menu.*

The TEC tuner window is selected from the Functions menu (see Figure 5and Figure 6**Error! Reference source not found.**).

Note: all pop-up windows can be closed by the normal Windows conventions, including pressing ALT+F4.

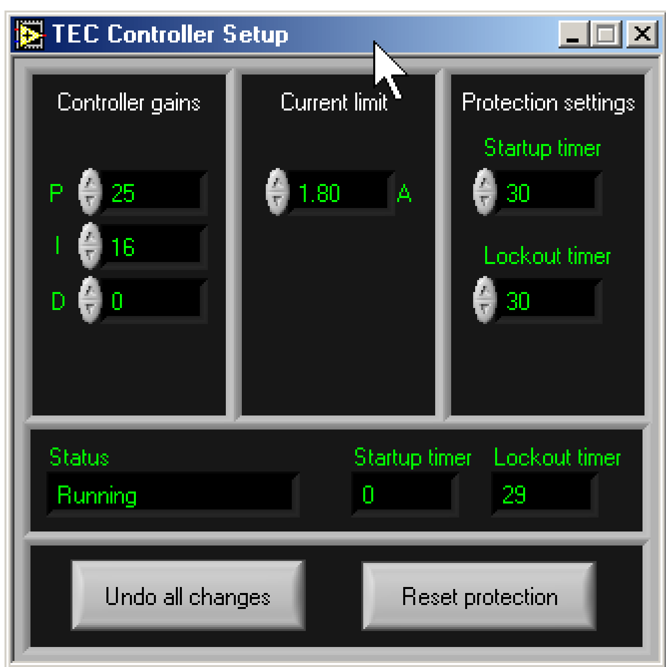

Figure 6: *The TEC Controller Tuner block.*

IMPORTANT NOTES:

1) ***If the TEC is stable the temperature traces should settle to a steady state after a short period. However, if oscillations of increasing magnitude are evident in the temperature trace the TEC is unstable. If this is the case IMMEDIATELY DISCONNECT power from the board and remove the device. Power up again, and continue with the procedure detailed below.***
   i) *Turn I, D controls to zero at this point, and turn P to some low value such as 10.*
   ii) *Use* Functions > Save settings to board *so that the board will remember these settings when power is reapplied.*
   iii) *Remove power, re-insert the device, reapply power, and connect to the board again. The TEC should now be stable and you can continue with the tuning procedure below.*
2) ***If the temperature continues to deviate further from the set point the TEC is connected backwards. Disconnect the power immediately. (Ensure that the correct device mount is being used. In the case of driving an SOA this should not happen as the MSA pin-out defines the TEC polarity)***
3) ***If either of these conditions arises, the built-in lockout mechanism will probably disable the TEC and current source within a few seconds. The power must be cycled (or the Reset Protection button pressed) to reset the board.***

Note: *Functions > Save settings to board* will remember the current source setting and the TEC temperature set point too. For example, if you use the save settings feature while the current source is turned on, then it will come on whenever you power the board up (after the TEC has stabilised). This feature allows the board to be used in standalone applications with minimal user input. See 3.3 below for more details.

3.2.1 Recommended tuning method:

1) Set the I and D controls to 0.
2) Increase the P value until the controller begins to oscillate, then back it off to get reasonable stability. Test by turning the laser on and off at full current and observing temperature bounce.
3) Adjust D to minimise the temperature bounce. *(**Note**: Some packages (such as the Covega SOA) were found to be unstable even with very low amounts of D. This is because the package time constant is comparable to the TEC loop-sampling rate. In this case it is best to set the D to zero.)*
4) Adjust the I control until the controller starts to oscillate, then back off. Again, check behaviour by turning the laser on and off. *(**Note:** There is generally some bounce in the device temperature when large currents are suddenly applied to the device under test.)*

NOTE: If you allow serious oscillations to persist for long enough then the TEC driver may shut down. This also disables the current source.

3.2.2 Lockout:

The LDR features a safety lockout mechanism to reduce the risk of damaging the device by incorrect TEC controller settings, incorrect TEC wiring, or inadequate heat sinking. The mechanism is based on a combination of timers used to check the stability of the temperature over a given time period. The 'Start-up Timer' is used to allow the TEC to stabilise prior to the current source becoming enabled immediately after power up. The 'Lockout Timer' deals with stability when dynamic changes to the active device, e.g. changes in drive current or set temperature are applied when the device is active.

When power is initially applied to the board the current source is locked out and a TEC countdown timer is started. If the temperature is within ±0.5°C of the set point by the time the timer has expired, then the current source becomes active and can be enabled. However if the temperature does not reach the set point within this period then both TEC and current source are locked out and the device "ON"LED will start to flash.

Once the current source is enabled, the temperature error is continuously checked. If it strays outside the ±0.5°C band for a time exceeding that set in the 'Lockout Timer' then the TEC and current source are both locked out as described above.

There is currently no facility for adjusting the temperature tolerance however the duration of both timers may be altered if desired.

Note: The Start-up and Lockout timer settings are in sampling time units *not* seconds, with each time unit approximately $^{1}/_{3}$ of a second. Default values for the start-up and lockout timer are 30 units. The TEC will typically take 3-6 seconds to stabilise when the drive current is turned from 0 to maximum.

The *Reset Protection* button will reset the TEC driver if it has entered the lockout state and is equivalent to cycling the power OFF and ON.

3.3 Current Source (refer to **Error! Reference source not found.**: Figure 3 Panel ⊕)

The current source is turned on/off by pressing the *ON* button and the set current will then be applied to the device. The device active LED will light when the current source is on.

Before activating the current source first set the current limit for the device under test. If testing a device for the first time it is also advisable to return the set current slider to zero and then slowly increase the current in small steps while observing the power, voltage and temperature readings.

The set current can be changed by directly typing it into the box or by use of the slider button.

As the current is changed all monitored parameters will be displayed and updated automatically in the measurement panel, and the scrolling chart window.

The current source can also be used in constant power mode. Instead of setting the current, you can set the desired power in dBm (or mW) and the driver will try to maintain it using feedback from the photodiode. In this mode the current limit is still active.

Both the set current and the front panel current limit are controlled by a master current limit stored in the flash memory. See **Info block editor** section for details of changing this value.

3.4 Standalone Driver Configuration

The board can also be used as a standalone driver. Select *Functions>Save Settings* to save the state of the board to non-volatile memory. The LDC will then boot up in this state every time power is applied. **i.e. if the SOA is powered ON and the user selects *Functions>Save Settings to Board* then the next time the device power is cycled the driver will power up and apply drive current to the attached device once the TEC has stabilised. It is essential that the operator is aware of this when using a demountable system where**

the device under test could potentially operate at a lower current than that which the driver will be set to deliver.

3.5 L-V-I Plotter

Using Version 2.2 and later of the driver software, it is possible to plot L-V-I (Optical Power-Voltage-Current) curves. These can be viewed on the screen or exported in the standard .CSV (comma separated value) format readily suited to standard spreadsheet packages (Microsoft Excel etc.).

3.5.1 How to use the L-V-I Plotter

Make sure the board is powered up and the driver software is connected successfully.

1) Select *Functions>L-V-I Plotter*. The L-V-I Plotter window should appear.
2) Choose the start current, end current, and number of points to plot, Figure 7**Error! Reference source not found.**. ***Note:*** If you set an end current higher than the current limit (set in the main window) the current limit will take priority.
3) Click the *PLOT* button. The graph will update as each point is recorded. You can stop the process at any time using the *ABORT* button.
4) While the L-V-I plotter is active, it takes control of the current source (and TEC driver). The laser drive mode, current set point, and on/off controls are grayed out and will not work. It does not matter what these controls are set to when you start the plot.
5) Once plotting has finished, you can save the result using the *SAVE AS CSV* FILE button. A dialog box will appear asking you to specify a name for the file. No default file extension is included and the user must specify .csv if desired.
6) Any text you type in the *Add comment* box (before pressing the *SAVE AS*… button) will be included in the file so that it appears at the top of the file when opened.

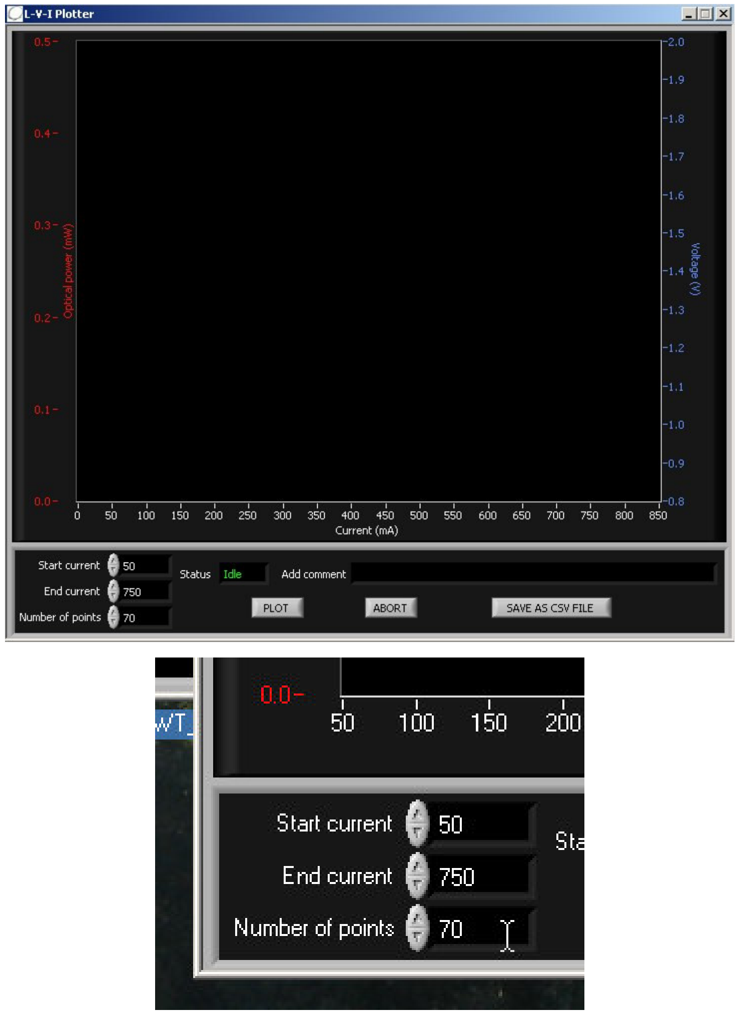

Figure 7: *LVI Plotter screen and settings*

3.6 Power Monitor Setup

The LDC may be configured to display the reading from the monitor photodiode in either dBm or mW. This option is selected under *Functions > Power Monitor Setup* (Figure 8**Error! Reference source not found.**). Under this window the user can select the *Display Units* and also select *Wavelength Calibration* data. *The display units setting also affects the settings for constant power mode.*

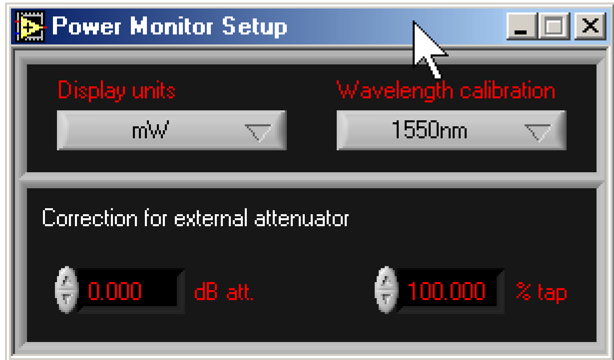

Figure 8: *Power Monitor Setup window*

If using either a high power device with an attenuator or a tap coupler in an application the attenuation factor (or coupling ratio of the coupler) can be entered in this window such that the display in the main window reads the actual output power of the device. The dB attenuation factor should be entered as a positive number.

4. The Info Block Editor

4.1 Introduction

The LDC board has a non-volatile flash memory bank that stores data even when the power is removed. This has two purposes:

1) Storing "inventory data", that is data which might be of interest to the end user such as serial number, type, etc.
2) Storing "calibration data" which is used by the LDC software to convert its internal digital readings into physical units such as mA, dBm, °C.

This memory bank is not normally intended to be edited by the end user. It is provided for use by the OEM, system integrator, etc. A "customer" version of the LDC software is available with the info block editor function removed. The inventory data is still displayed but cannot be edited, and the calibration data is not displayed at all.

4.2 How to edit inventory/cal data

The inventory and calibration data can both be edited using the Info Block Editor. The board must be powered up and the LDC software connected to it.

Select Functions>Info Block Editor:

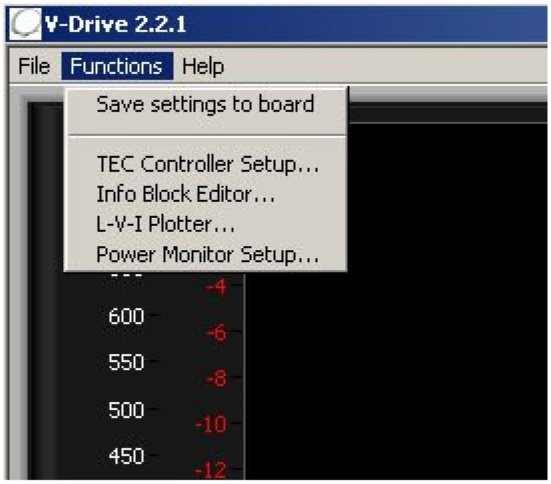

Figure 9*: Select Info Block editor under the Functions menu*

The Info Block Editor appears:

Figure 10: *The info block editor*

The Info Block is organised as a table, each box holds a "tag" of up to 16 characters.

******The tags beginning with an underscore are "cookies" used by the system when decoding the info block. Do not change them or the board may stop working altogether and need to be returned for reprogramming.***

The area between the _INFO and _CALDATA tags is for inventory data: you can enter anything you like in any of these boxes.

The area between _CALDATA and _END is used by the software. It expects to see the keywords CURRENTCAL, POWERCAL, etc. in the left-hand column, so do not alter these.

In the right-hand column are the calibration constants corresponding to these keywords. You can edit these to modify the behaviour of the board.

4.3 Calculating new calibration constants

NOTE: all these values are factory set and there should be no need for the user to change any of them. The only parameters that may need to be changed are POWERCAL (if using an attenuator, say) or CURRENTLIMIT (if using a different device family)

CURRENTCAL:	Sets the scaling of the current readout and set sliders, and the scaling of the current limit.
POWERCAL:	Sets the scaling of the optical power readout. This figure multiplies the photodiode current before it is converted to dBm. The transimpedance amplifier and photodiode are specified for operation with a max. incident power of +2dBm.
APCVOLTCAL:	Sets the scaling of the device forward voltage readout.
TEMPACAL: TEMPBCAL:	Are the Steinhart constants "A" and "B" respectively, for the thermistor. In practice these constants do not change very much between different brands and batches of 10k NTC thermistors. This version of the software uses hard coded values for these constants and changes to these parameters will have no effect.
CURRENTLIMIT:	Sets the master current limit. This determines the maximum value of the set current slider and the maximum of the current scale on the graph.
ITECAL:	Sets the scaling of the TEC current readout.
VDDCAL:	Sets the scaling of the supply voltage and TEC voltage readouts.
IPDOFFSET:	Nulls the transimpedance amp offset.
ILDOFFSET:	Nulls the device current sense amp offset.
PCNAME:	Sets what will be displayed in the Power Monitor Setup Dialog Box e.g. 1550nm

PWRCAL2, PCNAME2 etc. are as defined above for the alternative wavelengths.