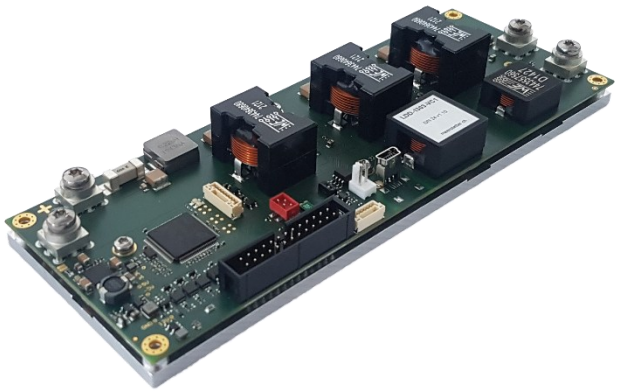
User Manual – LDD-130x





LDD-130x:

LDD-1301
LDD-1303

meerstetter engineering

Member of Berndorf Group

Developed, assembled, and tested in Switzerland

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Meerstetter Engineering GmbH
Schulhausgasse 12
CH-3113 Rubigen
Switzerland

Phone: +41 31 529 21 00
Email: contact@meerstetter.ch

Meerstetter Engineering GmbH (ME) reserves the right to make changes without further notice to the product described herein. Information furnished by ME is believed to be accurate and reliable. However typical parameters can vary depending on the application and actual performance may vary over time. All operating parameters must be validated by the customer under actual application conditions.

Document 5261I

LDD-130x Firmware Version v2.30

Release date: 30 July 2026

1 Introduction

This manual covers the functionality of the LDD-130x digital (laser) diode drivers.

Most of the explanations in this document assume that you use the “LDD-130x Configuration Software”, but all the operations can also be done by your own application if you implement the functionality. Most of the commands are documented in our communication protocol documents.

If you cannot find the feature or setting you need, please do not hesitate to contact our support. We do also provide customized firmware solutions.

1.1 Important Documents

- Datasheets
  - Technical specifications
  - Hardware configurations
  - Ordering information
- Communication Protocols
  - Protocol specification
  - Commands, Parameters
  - Example Applications and APIs
- Temperature & Light Sensor Cable Specifications
  - Pinout
  - Temperature sensor and photodiode assembly
- Temperature Sensor Suggestions
  - Description, part numbers and distributors for NTC sensors
- Application Notes
  - Additional Information about various usage scenarios of our devices

1.2 How to Contact Support

For optimal technical assistance we need the following information:

- Configuration file, exported while the error is present
  - Click on the “File → Export Config” option in the menu bar of the main window.
- Monitor History
  - In the "Log" window, click on the "Export to Excel" button.
    This window can be accessed by clicking on the "Log" button or by clicking on the "Tools → Log" option in the menu bar in the main window.
- A picture showing your system, the controller and the sensor leads.
- Datasheets of your diode, Peltier element, power supply and any other important parts involved in your setup.

You can also use the TeamViewer software from our website for a remote-control session. As soon as you start the tool we will recognize you, but please make sure to call or message us beforehand.

1.3 Software Requirements

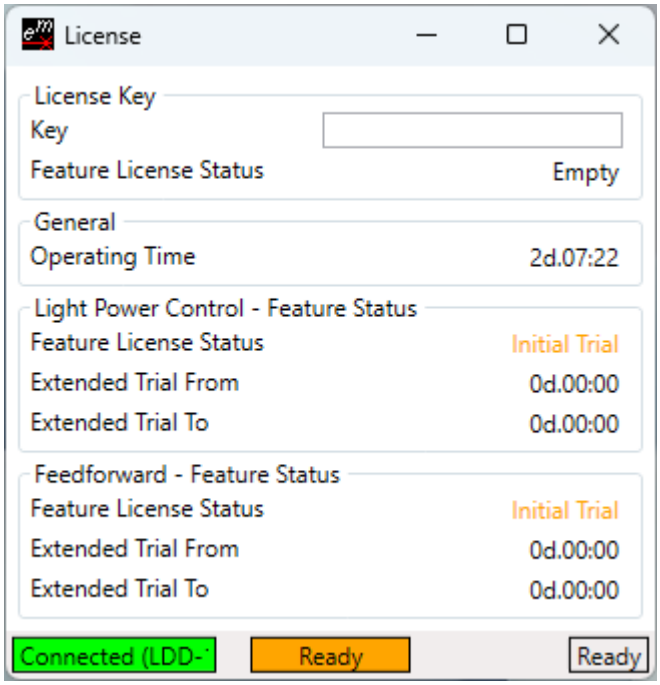
The Configuration Software is built on top of .NET 8 by Microsoft. Unlike the older .NET Framework, that the previous Service Software was based on, this runtime is not installed on the Windows operating system by default. Therefore, to be able to run the Configuration Software it is necessary to first download and install the .NET 8 Desktop Runtime. This runtime can be downloaded from the following page on the official Microsoft website: Download .NET 8.0 (microsoft.com). Alternatively, the Configuration Software will display a corresponding dialog when it is launched without the runtime being installed on the machine.

1.4 Licenses

Some device features are only available with an additional License Key.

All features are enabled during the first 150h Operating Time.

If you need more time to test the functionality, please contact our sales team.



1.4.1 Laser Power Control

Controls the nominal output current based on the measured light power.

More Information: 4 Operating the Light Power Controller

1.4.1.1 Feature Unlock Migration

The light power control (LPC) feature can be loaded via a software license starting with firmware v2.20. Please note that not all devices are eligible for this software license. Older devices without the -PD? (formerly -LPC?) product string require a hardware upgrade before the LPC feature can be used. Devices which were bought with the LPC option before software licenses were introduced are eligible for a free license. Please contact Meerstetter Engineering support@meerstetter.ch if you bought your device with the LPC option and wish to use a firmware version greater or equal to v2.20.

1.4.2 Feedforward

Controls the nominal output current based on the previously determined characteristics of the output.

More Information: 10 Feedforward Control

2 Basic Functions

2.1 The Status Bar of the Configuration Software

The bottom row of the software is always visible and shows the following information:

- Left: Connection status
- Middle: Device status (clicking on this control element will perform a Reset of the device.
    - Ready: normal standby status (no errors). Output stage disabled.
    - Run: normal operating status (no errors). Output stage enabled.
    - Error: an error occurred. Output stage disabled.
    - Bootloader: the firmware is being updated.
- Right: Unsaved parameters status (clicking on this control element will save the unsaved parameters onto the connected device)
    - Transparent: No unsaved parameters present.
    - Orange: Unsaved parameters present.
        - By hovering over this control element in this state, you may see a list of currently unsaved parameter changes.

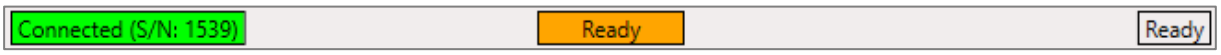


Figure 1: Status bar at the bottom of the Configuration Software.

2.1.1 Status LEDs and Configuration Software Status

LDD-130x devices feature two status LEDs. In normal operation, the green LED is blinking.

In case an error occurs, the device enters an error status and the red LED is lit. Power circuitry (output stage) is immediately deactivated to ensure safety. Control, monitoring and communication circuitry remains active. In case of software / configuration errors (i.e. not hardware faults), parameters can be reconfigured on the fly. The device needs to be software-reset or power-cycled to clear the error status.

Table 1: Status LED description.

Green LED	Red LED	Signification
Blinking slowly (~1 Hz)	-	“Ready” status (no errors). Output stage disabled
Blinking fast (~2 Hz)	-	“Run” status (no errors). Output stage active
-	Static on	“Error” status. Output stage disabled
Static on	Static on	“Bootloader” status
Blinking	Blinking slowly	Unreleased/Custom firmware is running on the device.

When the Configuration Software is connected to a device, the status of the device is displayed at the bottom of the software window.

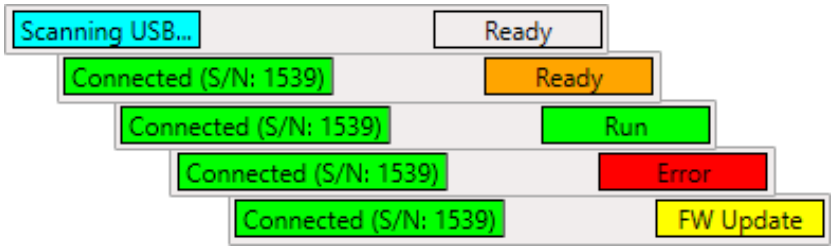


Figure 2: Configuration Software color codes for connection and device status.

Error Status:

If the device enters an error condition, please hover over the red status control element that shows the "Error" text at the bottom of a window. There you can find the error number and description as well as further steps you can take to mitigate the error or reset the device.

Alternatively, you can find a list of all errors at the end of this User Manual.

2.1.2 Reset the Device

Whenever the device enters an error state it is necessary to perform a "Reset" action to clear the error. This can either be done by power cycling the device or by one of the following options within the Configuration Software:

- Click on the "Device Status" control element in the middle of the Status Bar at the bottom of most windows.
- Use the "Device → Reset" option in the main window.

2.1.3 Writing and Reading Device Parameters

When a parameter value is changed, an orange circle ("Changed Icon") will appear next to it in the software. When hovering over this circle, it will display what the old value was and what the new value will be once written to the device. The old value can be restored by clicking on the circle, before the new value is written to the device.

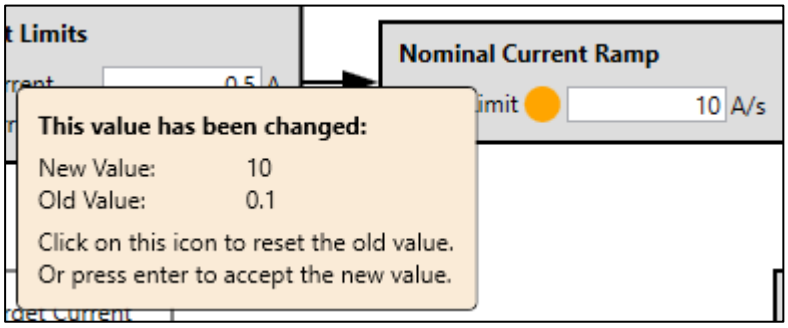


Figure 3: Example tooltip that is displayed when hovering over the orange "Changed Icon" next to a parameter that contains an unsaved change.

Changed parameters are saved to the device by either clicking on the "Unsaved parameters" field in the status bar of the software, through the "Device → Write Config" option in the menu bar of the main window or by hitting the "Enter" key when the focus is within a parameter control field.
When hovering over the "Unsaved parameters" field in the status bar, a list of all the unsaved parameters is displayed.

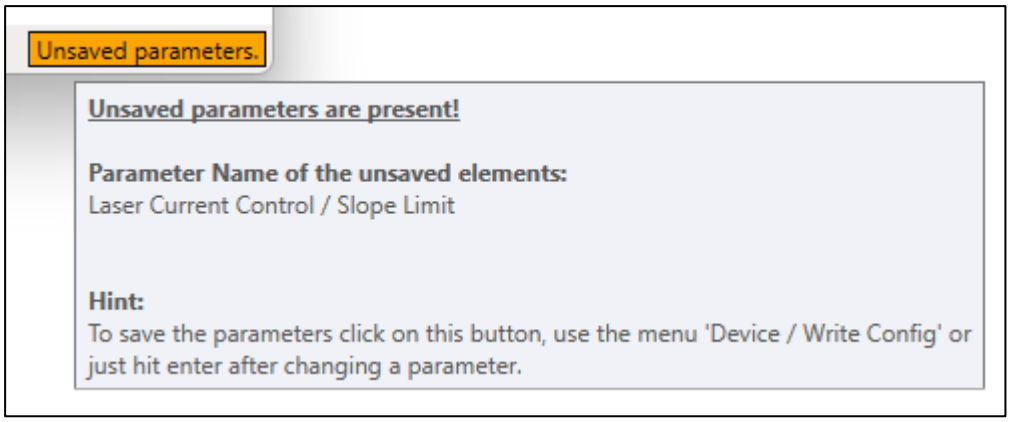


Figure 4: Example tooltip that is displayed when hovering over the "Unsaved parameter" field in the status bar.

All parameter changes are written in one go. Note that this also includes any changes on currently hidden or inactive windows.

To clear all unsaved parameters without writing them to the device perform a "Reset" or power cycle the device.

Parameters are read automatically when a connection to the controller is established.

Most settings are only read once at connect. If there are multiple communication interfaces active on the device, then settings can be changed over another interface without detection from the Configuration Software. In this case, “Device → Read Config” can be used to read all parameters again.

2.1.4 Importing and Exporting XML Configuration Files

Device configuration sets can be exported as backups, for replication onto other devices, or for support purposes. They are device-specific as they contain calibration data, but they can still be imported into other devices without issue, as any device-specific parameters will simply be skipped during the import process.

- **Export**
  - To save a configuration file on the PC, click on "File → Export XML Config" in the menu bar of the main window of the Configuration Software.
  - All actual values are stored. The values are useful for support and analysis.
- **Import**
  - To load a configuration file from the PC, click on "File → Import XML Config" in the menu bar of the main window of the Configuration Software.
  - Calibration data is only imported when the serial number in the configuration file matches serial number of the connected device.
  - To load a configuration file that was created using the Service Software, which used another format (.ini) than the Configuration Software, click on "File → Import INI Config". Note: Only the import of configuration files from the Service Software is supported. Please check all the parameters after importing.

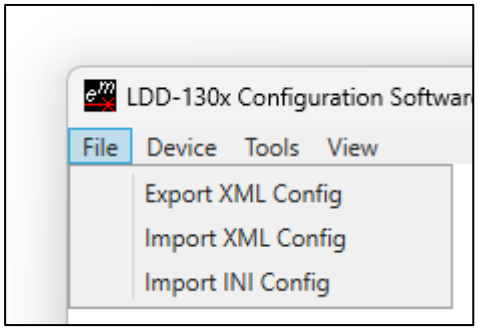


Figure 5: Import and Export Options in the Configuration Software.

2.2 Tooltips

The various input control elements of the Configuration Software, e.g., text input fields, dropdowns and radio buttons that are used to display and modify parameter values on the device, provide a variety of information in a tooltip when hovering over them.

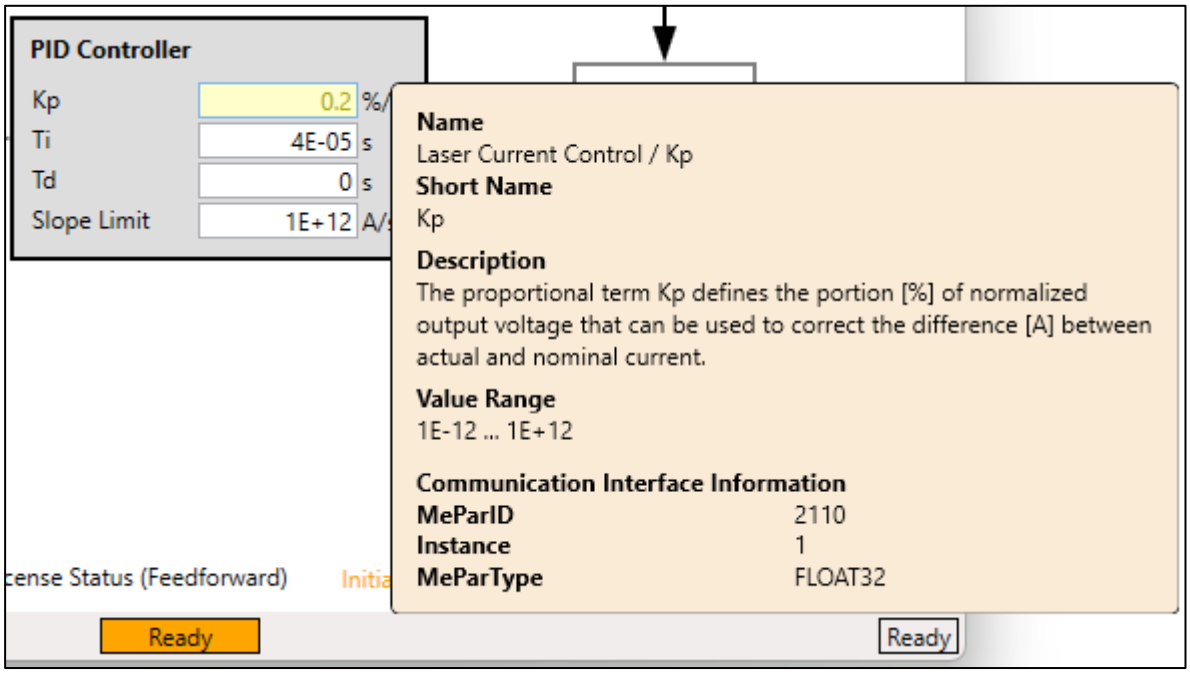


Figure 6: Tooltip of the PID K_p parameter (highlighted in yellow).

The tooltip does not only contain the full name and a short description of the parameter, but also "Communication Interface Information". These provide helpful information when accessing a parameter via the communication protocol, such as the parameter ID, the instance and the parameter type.

Keep in mind that some information in the tooltips is only available when the Configuration Software is connected to a device.

The tooltips are shown by default, but advanced users may disable them by unchecking the option "Enable Mouseover Tooltips without pressed CTRL" in the "Application Settings" window. This window is accessible via "View > Application Settings" in the menu bar of the main window. If this option is disabled, the tooltips will only appear while the CTRL (Control) key is pressed.

2.3 Remote Control Options

This is an overview of the different remote-control options for the device. It is possible to configure, control and monitor the device using any software which can communicate over an appropriate interface. In the "LDD-130x Communication Protocol 5260" document a list of the software options available from us can be found.

Generally, all parameters available in the Configuration Software can be read and written by other means using the communication protocol.

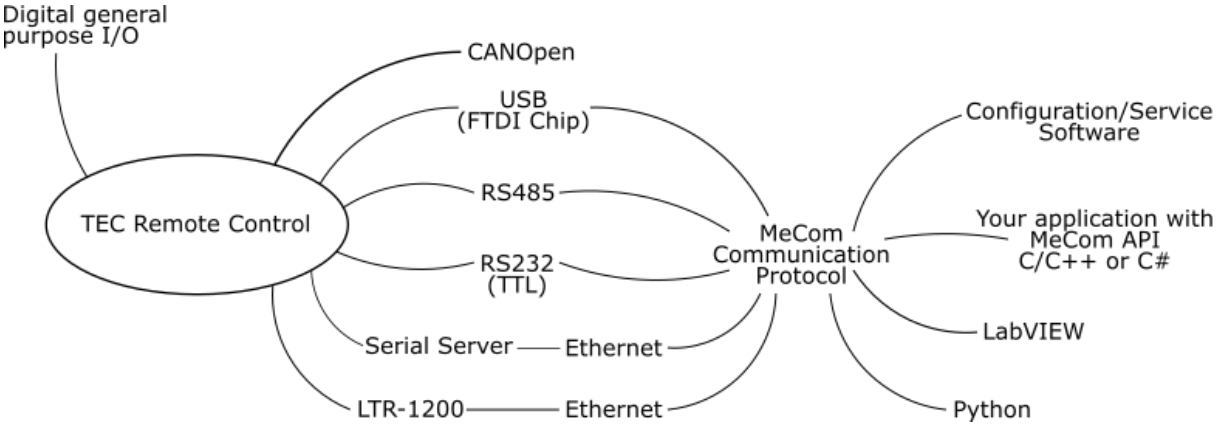


Figure 7: Remote control options. (TEC shown for illustrative purpose, check datasheet for actually available interfaces).

2.3.1 Serial Communication

Serial communication is used to send data from a host to an LDD-130x and receive data from the device, respectively. The following physical interfaces are supported:

- USB
- RS485 (check out our TEC Application Note - RS485 Interface, valid for LDD-130x too)
- RS232 TTL

Communication using the Configuration Software and RS485 is only possible using a USB–RS485 adapter or an Ethernet serial server, since the Configuration Software only connects to FTDI[1] chips or TCP port 50'000.

2.3.1.1 Addressing specific devices

Assign a unique "Device Address" to the device if multiple devices are operated on the same bus. The "Device Address" can be set within the "Communication" window when the Configuration Software is already connected to the device. You can then tell the software to use a specific device address to communicate with a device. To do this, open the "Connection Criteria Manager" window from the "Tools" menu in the menu bar of the main window and look for the "Device Address" input field. For more application arguments, check out the Communication Protocol document.

Note: All devices have a 1-unit load receiver input impedance, allowing up to 32 transceivers on the RS-485 bus.

[1] One option is the USB RS485 converter cable from FTDI Chip, available in different lengths.

2.3.2 Ethernet Communication

It's possible to use a standard Serial Server to connect our devices to an Ethernet interface. We have tested devices from Lantronix (e.g. XPort, UDS1100) and Moxa (e.g. NPort 5130). Please check TEC Application Note - RS485 Interface, valid for LDD-130x devices too.

2.3.3 CANopen

This device supports CANopen according to CiA 301. Please refer to the "LDD-130x Communication Protocol 5260" for further details.

2.4 Firmware Updates

You can download the firmware (contained in the software package) from our website and update your devices using the Configuration Software.

The Configuration Software and the firmware are strongly related. Only when a Configuration Software and a firmware with a matching version number are used the full functionality can be guaranteed. However, it is usually possible to connect to a device with an old firmware with a new Configuration Software and vice-versa. Functionality will be limited, but firmware updates are possible.

Matching version numbers: All our published software has a version number similar to this: “vX.YZ”. It is important that at least X and Y is matching. Z can be different.

Follow these steps to update devices:

- Read the LDD-130x Software Release Notes document.
- Backup the current configuration. This is important because it is possible that the current configuration will be lost during the update.
- In the main window click on “Device → Firmware Update” in the menu bar.
- Click on "Select *.hex File" and choose the new .hex file.
- Click on "Start Update Firmware" to load the new firmware on the device.
- The device will reboot once the update has completed.
- You can check the firmware version in the “System” window.
- Re-import the previously exported .xml configuration file (if necessary).
- Fill missing parameter values into new parameter fields (if applicable).
- Check whether all parameter settings still match your expectations. Consult the LDD-130x Software Release Notes as well as the corresponding communication protocol document to learn which parameters have been changed.

3 Operating the Current Driver

3.1 Theory of Operation

LDD-130x devices feature an output current stage controlled by a PID Controller, which is implemented in the microcontroller.

The devices differentiate themselves in their capabilities. For technical reasons, the position of the current measurement differs, as shown in the diagrams. As a consequence, while in the LDD-1301 the cathode is connected to the board's ground, on the LDD-1303 the cathode needs to be floating.

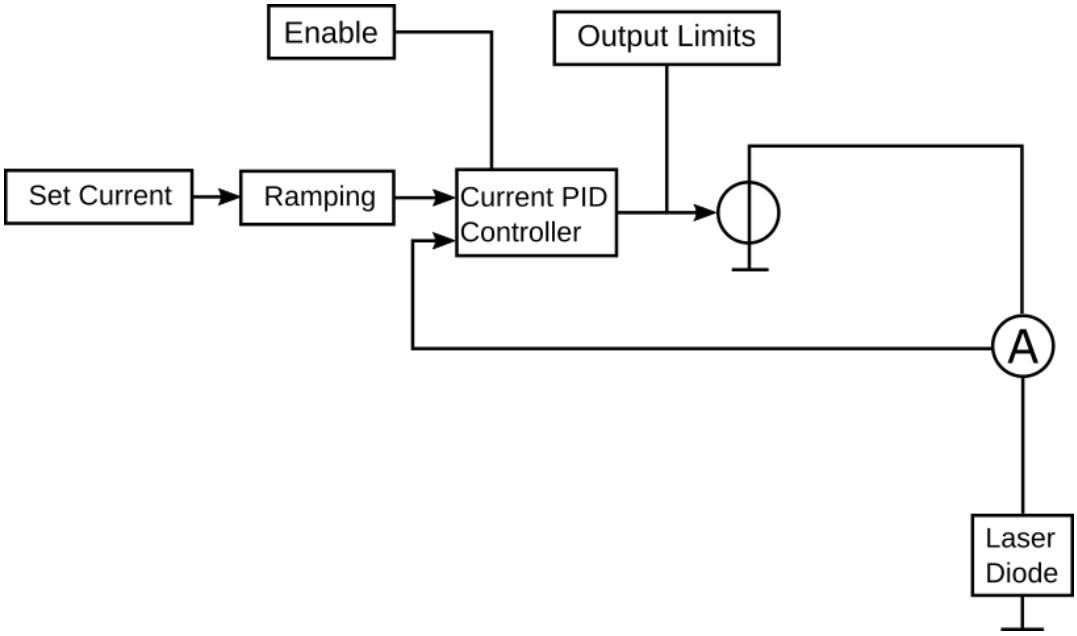


Figure 8: Functional overview of the LDD-1301.

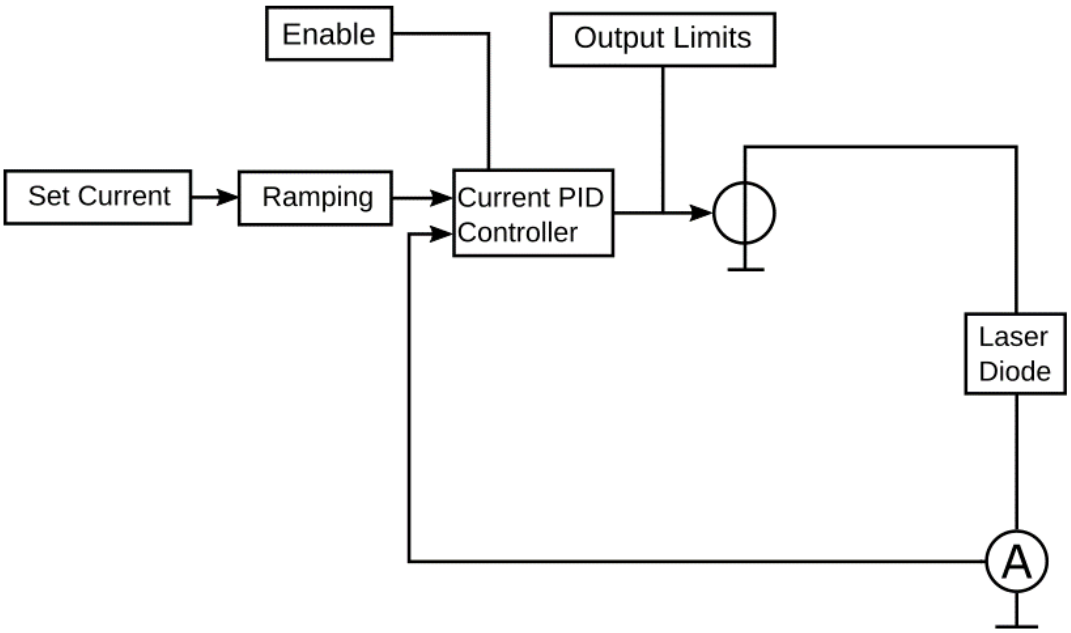


Figure 9: Functional overview of the LDD-1303.

3.2 Driver Settings

3.2.1 Output Settings

In the main window you can set the Nominal Output Current to be controlled from four sources:

- from the light power control feature[2],
- from the analog input feature[3],
- from the lookup table feature,
- from the signal generator feature.

Additionally, the source can be set to “Set Current”. This allows setting the target current directly.

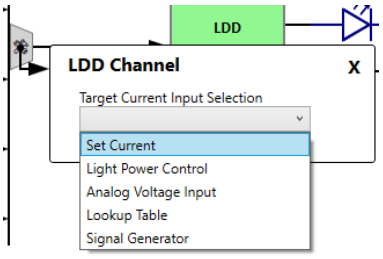


Figure 10: Output Current selection

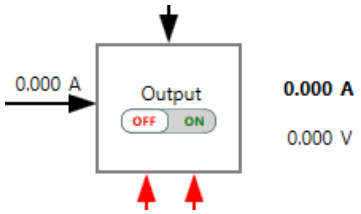


Figure 11: Output Enable switch

The output is activated by the “Output Enable” switch either in the “Laser Current Control” window or the main window. If saved to flash, this remains active even after a power cycle or reset, unless the “Always off after Reset” parameter is set to “Enabled”.

The output stage nominal current limit settings allow to define limits for the nominal current that will be enforced regardless of the current you set. These should be set to reflect the normal operating range.

The error thresholds are important safety settings which when crossed, will cause the device to go into error mode and consequently shut down its output stage. You should set these in order to protect your connected diode from regulation or configuration issues. This value should always be set within the absolute maximum current rating of the laser diode you’re using.

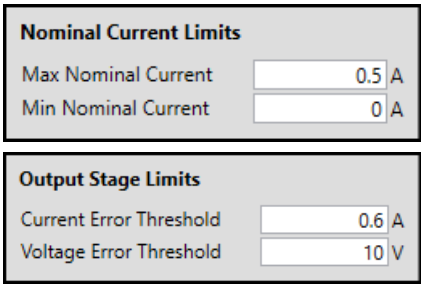


Figure 12: Output Stage Limits.

[2] See the relevant chapter for how to set up the light power control
[3] See the relevant chapter for how to set up the analog input control

3.2.2 Current Controller Settings

These settings, again in the “Laser Current Control” window, define the behavior of the current regulation. The current stage is regulated by a PID controller.

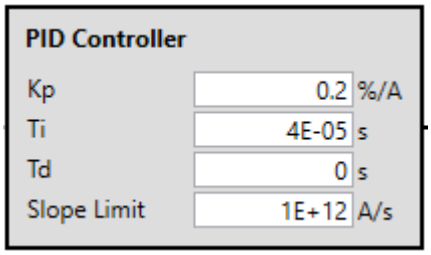


Figure 13: Current Controller Settings.

The proportional term K_p defines the portion [%] of available current that is used to correct the difference [A] between actual and nominal CW current.

The integral term T_i defines the reset time [s] the regulator is allowed to take for correcting a given control deviation. The effect of T_i is weak for large values and strong for small values.

The derivative term T_d opposes changes in control deviation, weighed by unit time [s]. The dampening effect of T_d increases with larger values (e.g. a value of 0 results in bypassing the D component).

The “Slope Limit” acts on internal nominal current ramping and allows the use of more aggressive PID settings.

4 Operating the Light Power Controller

4.1 LPC Prerequisites

This feature is only available on devices which contain -PD? (formerly -LPC-??) in their product string and requires a software license to use. See chapter 1.4 Licenses for more information.

4.2 Theory of Operation

LDD-130x devices feature an optional cascaded PID Controller to control the emitted light power of laser diodes. This control is also implemented in the microcontroller.

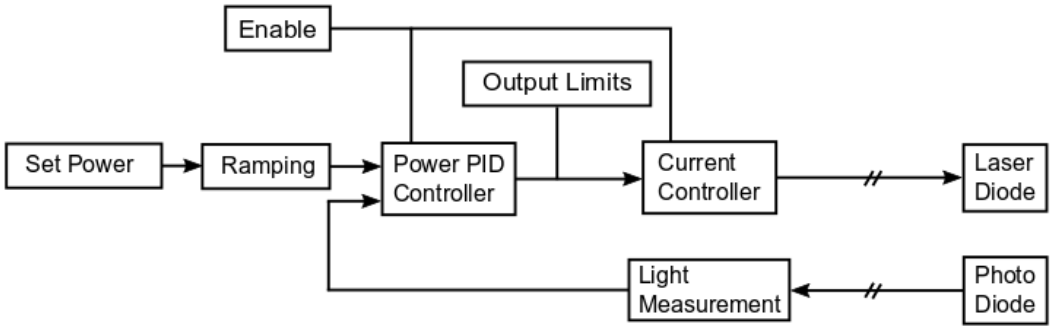


Figure 14: Functional overview of the light power control on LDD-1301/1303.

4.3 Controller Settings

4.3.1 Output Settings

In the main window, the Nominal Output Current can be set to “Light Power Control”, meaning the light power PID controller’s output is connected to the input of the PID controller of the current driver.

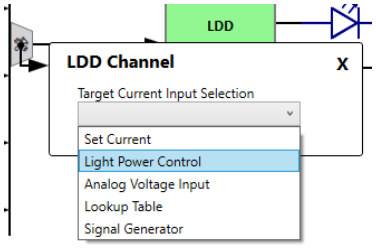
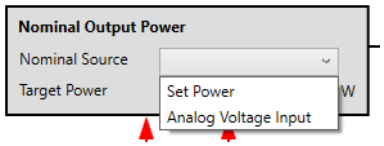
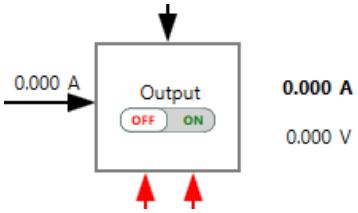


Figure 15: LPC selection



In the “Light Power Control” window the Nominal Output Power can be either set directly or controlled by the analog input.

Figure 16: Output Power selection



The output is activated by the “Output Enable” switch either in the “Laser Current Control” window or the main window. If saved to flash, this remains active even after a power cycle or reset, unless the “Always off after Reset” parameter is set to “Enabled”.

Figure 17: Output Enable selection for LPC

The output stage nominal power limit settings allow to define limits for the nominal light power that will be enforced regardless of the light power you set. These should reflect your target operating range.

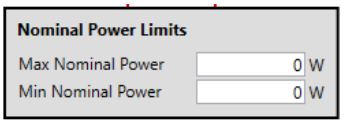


Figure 18: Output Stage Limits for LPC

4.3.2 Power Controller Settings

These settings, again in the “Light Power Control” window, define the behavior of the light power regulation. The current stage is regulated by a PID Controller that is regulated by a cascaded PID Controller.

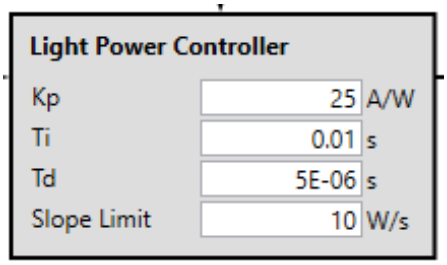


Figure 19: Power Controller Settings for LPC.

The proportional term K_p defines the portion [A] of available light power that is used to correct the difference [W] between actual and nominal CW light power.

The integral term T_i defines the reset time [s] the regulator is allowed to take for correcting a given control deviation. The effect of T_i is weak for large values and strong for small values.

The derivative term T_d opposes changes in control deviation, weighed by unit time [s]. The dampening effect of T_d increases with larger values (e.g. a value of 0 results in bypassing the D component).

The “Slope Limit” acts on internal nominal light power ramping and allows the use of more aggressive PID settings.

5 Lookup Table

It is possible to download a table containing a customized waveform. This waveform can be used to control the laser diode current.

Please make sure that the input source selection is set properly when using a lookup table.

All lookup table functionality is also provided by the communication protocol using the LUT parameters.

5.1 Table Definition

The .csv file is structured as follows.

The header row contains 2 or more columns, the first row being “Table Instance” followed by columns containing the table instance numbers. A maximum of one table instance is currently supported. The following rows define the table instance values, starting from the second row. For further information see “LookupTable Example.csv”.

Up to 1000 samples are possible in each table. Please keep the analog bandwidth and current update rate in mind when defining waveforms. Furthermore, make sure the configured slope limit is suitable for the defined waveform.

For a visualization of the example waveform open the “LookupTable Example.xlsx” Excel sheet.

5.2 LUT Configuration

From within the LDD Configuration Software, the lookup table configuration can be found in the “Lookup Table” window.

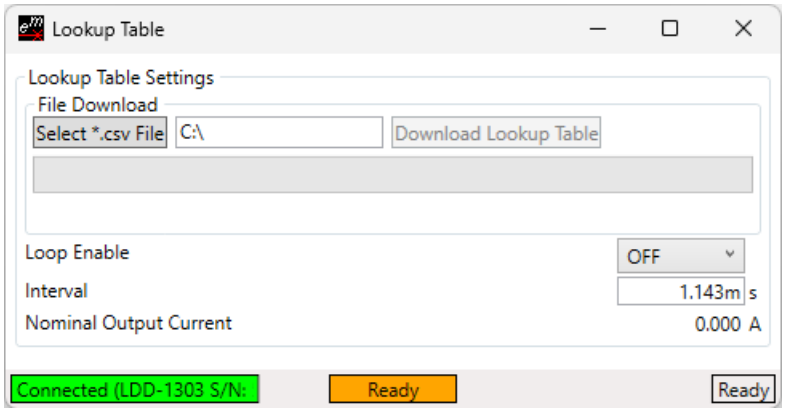


Figure 20: Lookup Table window

The “Loop Enable” parameter controls whether the table repeats itself indefinitely or stops upon reaching the last record.

The “Interval” field controls the sample interval of the table defined in seconds. The underlying parameter uses cycles which are 22.85714 microseconds each. The software will choose the closest approximation of your input value.

Load the externally generated table into the LDD’s memory by using the “Select *.csv File” and “Download Lookup Table” buttons. The table is downloaded as a .csv file.

6 Signal Generator

The LDD can generate a set of predefined waveforms which can be used to shape the laser diode current. It is also possible to specify a waveform using a Lookup Table, however the number of data points the table can hold is limited and defining certain waveforms manually may be difficult or tedious. When using the signal generator, the LDD will derive the signal from the mathematical definition of the signal instead.

Please make sure that the input source selection is set properly when using the signal generator. Furthermore, care must be taken when using the communication protocol as time parameters are specified in cycles.

6.1 Signal Generator Configuration

Open the “Signal Generator” window and select the waveform you need.

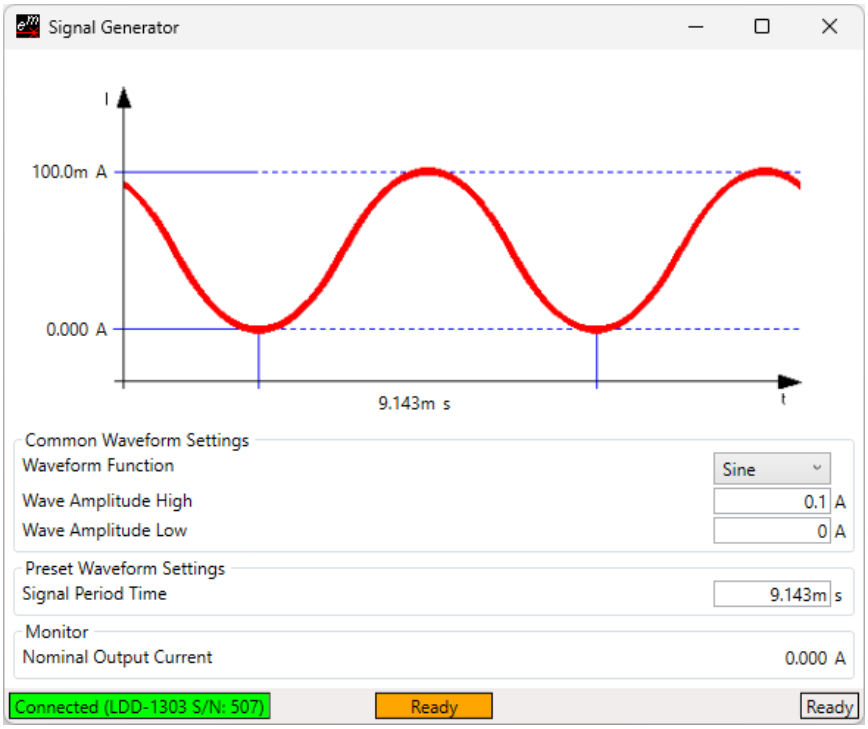


Figure 21: Signal Generator window

There are two parameters which apply to every kind of waveform: “Wave Amplitude Low” and “Wave Amplitude High”. Those two parameters define the lowest and the highest point of the waveform respectively. “Wave Amplitude High” must be higher than “Wave Amplitude Low”.

All time fields are specified in seconds. However, the underlying time parameters are stored in cycles which vary in length depending on the kind of waveform. Custom waveform cycles are 22.86 microseconds long while preset waveform cycles are 91.43 microseconds long (the minimum amount of cycles is 5). The software will choose the closest approximation of your input value. If you are unsure how the final waveform will look like you can use the current graph as a reference.

6.1.1 Custom Waveform

The custom waveform is the most configurable waveform and allows to define arbitrary trapezoidal waveforms. It has four parameters which are used to configure the rise, fall, high and low time.

6.1.2 Preset Waveforms

Preset waveforms only have one additional configuration parameter “Signal Period Time”, which defines the length of the signal. There are three waveform presets: sine, square and triangle.

7 Temperature/Light Measurement and Analog Interfaces

7.1 Temperature Measurement

This input can accommodate NTC sensors.

Error thresholds to protect your load against overheating are available in the “External Temperature Input x” window in the “Surveillance” box. They can be activated via the setting in the error dropdown menus. The error limits can be set individually for every external input channel.

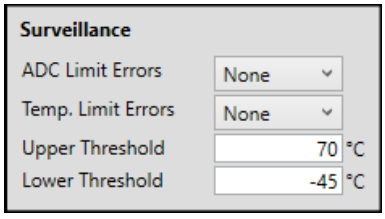


Figure 22: External Temperature Error settings

If the “ADC Limit Errors” are enabled, an error will be thrown if the NTC sensor has reached a resistance value that is at the edge of the measurable range of the controller. It offers a selection of different threshold detections, one for only the upper value, another only for the lower value and one for both.

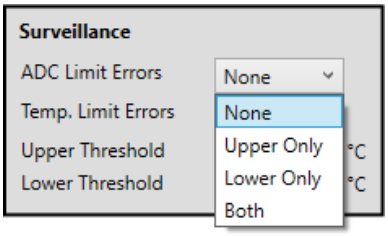


Figure 23: ADC Limit Errors

If the “Temperature Limit Errors” are enabled, the crossing of the thresholds set in the “Surveillance” box will be detected and cause an error. It offers a selection of different threshold detections, one for only the upper value, another only for the lower value and one is for both.

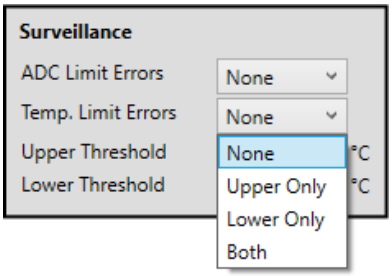


Figure 24: Temperature Limit Errors

The “Temperature Calibration” located in the “Temperature Conversion” box allow additional user calibration for each temperature input.

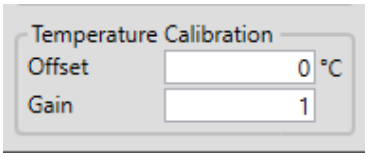


Figure 25: External Temperature User Calibration

The “Measurement Limits” are calculated values showing the range of measurable resistance of the input. The corresponding maximum and minimum temperatures are calculated for each temperature input using the sensor characteristic found in the “External Temperature Input x” window.

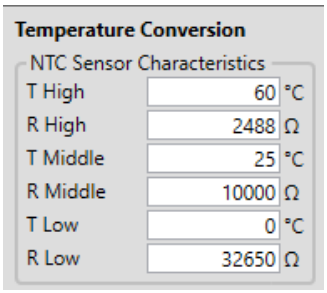


Figure 26: External NTC Sensor Characteristics settings

7.1.1 Temperature Correction of the Output

In the “Temperature Correction” window you can activate a temperature-dependent contribution to the target current.

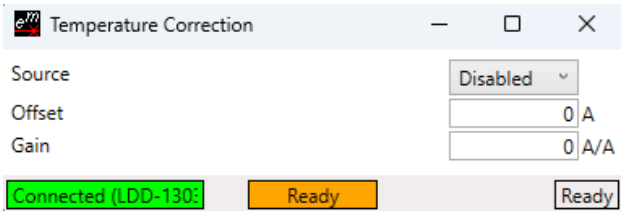


Figure 27: Temperature Correction settings

This can be used to compensate variations in the light output of your laser due to temperature variations, in the absence of optical feedback. The Gain and Offset parameters are used in the following formula:

$$I = I_{set} + \text{Gain} \cdot (T - \text{Offset})$$

Where T is the temperature input you selected via Source, I_{set} is the nominal current you set as when using the controller normally, and I is the actual nominal current that the LDD will follow. This final value can be observed in the “Laser Current Control” window as the “Nominal Output Current” parameter.

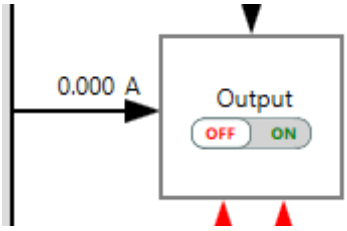


Figure 28: Monitor Value of the Nominal Output Current.

7.2 Light Measurement

The optional light measurement input offers the possibility to observe the photodiode current via a parameter shown on the “Photodiode Input” window. In absence of the feature the value will be stay on NaN.

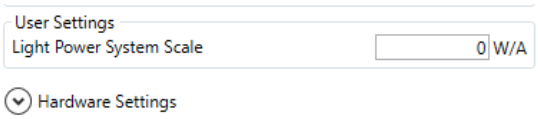


Figure 29: Light Power Factor

Through the parameter “Light Power System Scale” LP_{Gain}, the conversion factor to translate the photodiode current I_{Ph} into an emitted light power P_{Light}, can be defined. This is required for operating with the light power control. This parameter depends on the photodiode and the optical coupling of the system. You can set this arbitrarily in the absence of an absolute reference measurement.



Figure 30: Monitor values of the Photodiode Input.

$$P_{Light} = \frac{I_{Ph}}{LP_{Gain}}$$

The above formula shows the relationship between the emitted light power and the photodiode current LP_{Gain}. The light power is also displayed in the “Photodiode Input” window, “Light Power Control” window and the main window.

7.2.1 Photodiode Input Setting

In the “Photodiode Input” window you can set a resistance value for the photodiode input. Note that “Photodiode Rs” depends on the PD hardware configuration and does not need to be modified by the end user.



Figure 31: Photodiode Input setting

The values correspond to each PD configuration according to the following table:

Photodiode Rs [Ω]	PD Configuration [mA]
5600	0.5
2700	1
1300	2
680	4

Table 2: PD configurations

7.3 Voltage Output

The voltage output in the “Analog Interfaces” window can be used to provide a synchronization output (i.e. a voltage signal with the same waveform as the measured output current) or a voltage signal controlled by the “Set Value” parameter, which will output a fixed voltage. Configure the “Signal Source” to select between those two modes.

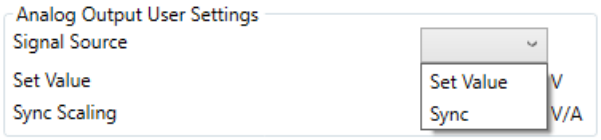


Figure 32: Analog Output settings.

This output runs with a frequency of 10 Hz.

“Sync Scaling” allows to set the output current to output voltage ratio.

7.4 Voltage Input

The analog voltage input is displayed in the “Analog Interfaces” window. To control the output current through this analog input, the Nominal Output Current in the main window can be set to “Analog” (this needs to be followed by a reset).

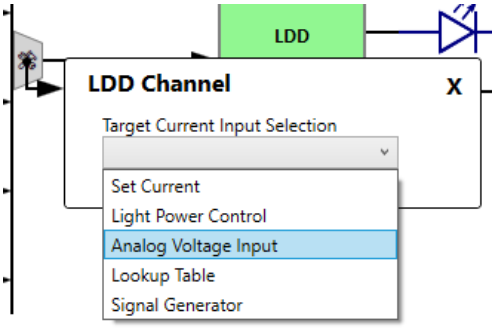


Figure 33: Output Current Setting for Analog Input.



Figure 34: Monitor value of the Analog Voltage Input.

The output current set by the Analog Input follows the formula below where *I* is the output current, $V_{AnalogIN}$ is the input voltage and *G* is the scaling factor “Current Factor”

$$I = V_{AnalogIN} \cdot G$$

The Current Factor parameter is used to convert the Analog Input Voltage into a corresponding Output Current and can be found in the “Analog Interfaces” window, in the “Analog Input” box.



Figure 35: Analog Input setting

8 Charting and Data Logging

8.1 Charts/Graphs

The graphs support multiple interaction options to adjust the view. The following interaction options can also be seen by hovering over the ? symbol in the top-right corner of the graph windows:

Option	Keyboard Shortcut
Show Datapoint Details	Left Mouse Button
Pan	Right Mouse Button
Zoom	Mouse-Wheel
Zoom by Rectangle	Ctrl + Right Mouse Button
Reset	Double-Click Middle Mouse Button
	Ctrl + Double-Click Right Mouse Button

8.2 Graph

The "Graph" window offers a convenient way of mid-term system characterization, e.g., for observing stability, or for optimizing PID control parameters.

All numerical parameters present on the device can be displayed in any of the graphs. To display a parameter in one of the graphs, click on the "Graph Parameter Settings" button in the "Graph" window, which will open the "Application Settings" window. Here, all parameters of the device are listed in a table within the "Graph Parameter Configuration" box. In this table, a parameter can be shown by clicking on the checkbox in the "Show" column. It can be assigned to a specific graph via the dropdown menu in the "Assignment" column. Furthermore, a parameter can also be shown in the graph by enabling the "Show in Graph" checkbox within its tooltip in the software.

By default, the graph will display the datapoints within a 10-minute range and it will always scroll the graph area automatically should the datapoints move out of the boundary of the X axis (time). The time range can be adjusted by modifying the "Graph Area [min]" setting and the automatic scrolling behavior can be disabled by unchecking the "Auto Scroll" option within the "General Settings" box.

It is recommended to close or minimize the Graph Window to save CPU capacity.

The Graph Window can show up to 4 charts.

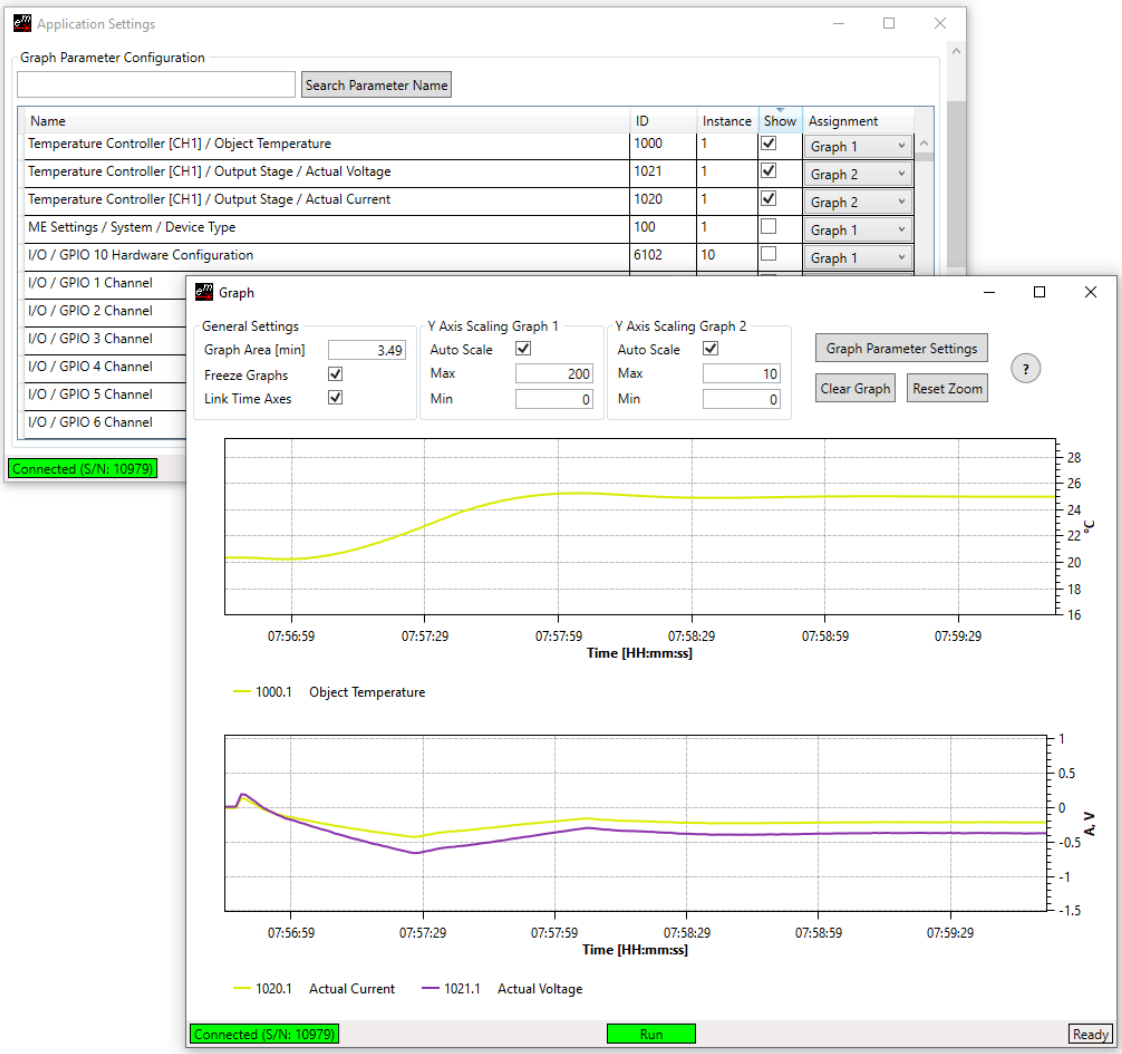


Figure 36: "Graph" window with its configuration in the "Application Settings" window on top.

8.3 Log

For external plotting and data analysis, logged data can be exported to an .xlsx (Excel) or .csv (Comma-separated values) file from the "Log" window.

- Each log entry is time-stamped.
- At relaunch of the software, the log is erased and the log interval is set to the smallest value of 1 second.
- The general data logging duration is limited to 24 hours. Afterwards, the data at the beginning of the log will be overwritten with any new log data (ring buffer).
- The graph makes use of this log data for its data points.
- For critical long-term monitoring we recommend exporting the log regularly.
- The export of the logged data contains all data of every single parameter on the controller.
- Certain parameters are logged only when they are changed (Setting parameters), and others are logged upon every interval tick (Monitor parameters). In the Excel log, these two types of parameters are each divided into their own worksheets, while the CSV log generates two files.

9 External Hardware

9.1 GPIO Control Signals

The GPIO control signals can be used for general purpose I/O (GPIO) or for predefined functions. The functions described in Table 3 can be independently assigned to the GPIO signals in the “I/O” window. Many functions are separately available as several channels. For those functions, the channel can be chosen in the “I/O” window as well. For the functions which are not available in multiple instances this setting has no effect.

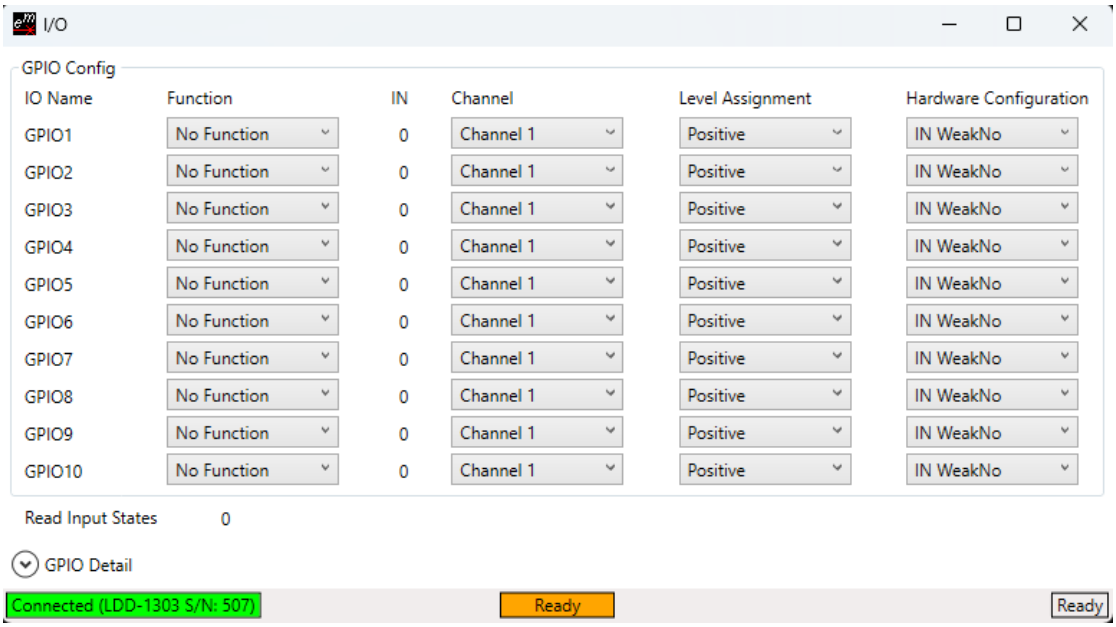


Figure 37: I/O window

Table 3: Available functions for the GPIO signals.

Function Name	Description
No Function	The GPIOx has no function. The pin is at high impedance state.
Signal Control	The GPIOx signal is used as digital I/O, controlled by the communication interface. Refer to the communication protocol document for more information.
LDD OK	The GPIOx signal is logic 1 if the device is in the “Ready” or “Run” state.
HW Enable (edge)	Same as “HW Enable” but requires an active edge after reset (see below).
HW Enable	The GPIOx signal is used as input to enable the output of the driver. If the signal is logic 1, the driver output is enabled. The value of parameter 2100 will be overwritten with the value provided by the GPIO.
Fan PWM	The GPIOx signal is used as PWM output for the Fan Control feature. Only selectable for GPIO5 and GPIO6 (see chapter 9.3 Cooling Fans). For this function, the "Hardware Configuration" is usually set to "OUT PushPull" to properly drive the PWM input of the fan.
Fan Tacho	The GPIOx signal is used as frequency input for the fan control feature (see chapter 9.3 Cooling Fans). For this function, the "Hardware Configuration" is usually set to "IN Weak Up", because the fan’s tacho output usually has an open collector output.

Function Name	Description
Toggle HW Enable	Toggled version of the hardware enable. A button press causes the state of the hardware enable to switch. Debouncing is built-in into the firmware.
LDD Run	The GPIOx signal is logic 1 if the device is in the “Run” state. Otherwise it is logic 0.
Pump	The GPIOx signal is set to logic 1 to enable a pump or other cooling devices. Use the "Pump Control x" settings by expanding the “GPIO Detail” at the bottom of this window to configure the thresholds. Two pump control channels are available.
Dev Addr +1 Dev Addr +2 Dev Addr +4	The GPIOx signal is used as input signal. For each pin which is logic 1 and with this function enabled, 1, 2 or 4 is added to the device address and CANopen Node ID. This is only done once at startup.
Fan Stop	The GPIOx signal is used as input signal. If this function is enabled and the corresponding pin is 1, the fan is disabled. If the pin is 0, the fan runs normally.
LDD Encoder A LDD Encoder B LPC Encoder A LPC Encoder B	The GPIOx signal is used as input signal. A Rotary Encoder is to be connected to the Encoder A and Encoder B inputs. It can then be used to change the target setpoint.
Fix 0	Sets the GPIO output to fixed 0. Can be inverted using the "Level Assignment" to get a fixed 3.3V output.
Pulse Input	When this pin is logic 0 the target current used by the current control loop is set to the Value of “Min Nominal Current”. When the pin is logic 1, the target current is left unaltered. (= Nominal Current) When multiple pins are configured as Pulse Input the GPIO with the highest number is used. If no GPIO is configured as Pulse Input the target current is left unaltered.
LDD CurrentUp LDD CurrentDown LPC PowerUp LPC PowerDown	The GPIOx signal is used as input signal. At every positive edge (transition from logic 0 to logic 1) the target setpoint is increased or decreased by the chosen step size. If the signal is logic 1 for longer than 1 s, the target setpoint is changed with increasing speed in the chosen direction (see chapter 9.1.1 Buttons for more information). Pressing both buttons simultaneously for 6 seconds locks or unlocks the buttons.
Reset Device	The signal is used as input signal. On a positive edge, the controller will start the reset process. The input is debounced for 100 ms.

The Logic Level of each pin can be assigned under “Level Assignment” in the collapsed “GPIO General” options within the “I/O” window. For inputs, Logic Level “Positive” means that a high voltage is read in as logic 1 while a low voltage (pin connected to GND) is logic 0. This can be inverted by setting the parameter to “Negative”. For outputs, the logic level inverts the Signal when set to “Negative”. This means that the “LDD OK” signal outputs 0 V when the LDD is in “Ready” or “Run” status and the Level Assignment is set to “Negative”.

The pins can be Individually configured under “Hardware Configuration” in the “I/O” window. When a signal is used as an input the hardware configuration must be set accordingly or the function will not be operational.

Table 4: GPIO Pins Hardware Configuration

Function Name	Description
IN WeakNo	The GPIO Pin is configured as Input. No PullUp or PullDown Resistor is activated.
IN WeakUp	The GPIO Pin is configured as Input. A weak PullUp Resistor to 3.3V of approximately 50kΩ is activated.

IN WeakDown	The GPIO Pin is configured as Input. A weak PullDown Resistor of approximately 50kΩ is activated.
OUT PushPull	The GPIO Pin is configured as Push Pull Output. No PullUp or PullDown Resistor is activated.
OUT OD NoPull	The GPIO Pin is configured as an Open Drain Output. No PullUp or PullDown Resistor is activated.
OUT OD WeakUp	The GPIO Pin is configured as an Open Drain Output. A weak PullUp Resistor to 3.3V of approximately 50kΩ is activated.

For input signals like buttons, it is usually easier to set the pin to “Negative” logic and “In Weak Up”. This way the switch can be connected between the GPIO pin and GND.

9.1.1 Buttons

The target setpoint can be changed through two buttons connected to the GPIO connector.

- It is recommended to connect the buttons between the GND pin and another GPIOx pin and set the Hardware Configuration to "IN WeakUp" and use negative logic.
- Pressing both buttons simultaneously for 6 seconds locks or unlocks the buttons.

The Buttons can be configured in the "I/O" window within the collapsed "GPIO Detail" options. See **Table 5** for a description of the settings.

Table 5: Target Current/Power Button Configuration

Parameter Name	Description
Upper Current/Power Limit	Specifies the maximum Target Current/Power which can be set by using the up button.
Lower Current/Power Limit	Specifies the minimum Target Current/Power which can be set by using the down button.
Step Size	Specifies the single step size, applied on every edge.

9.2 Rotary Encoders

The target setpoints can be changed by connecting a rotary encoder for each channel to the GPIOs.

- It is recommended to connect the rotary encoder common connection to GND and the outputs to the GPIOx pins.
- With continuous rotation the step size is automatically increased to facilitate large changes in the target setpoint.
- The direction of rotation in which the target setpoint is increased or decreased can be changed by swapping output A with output B and vice versa.

The "Step Size" and "Current/Power Limit" settings from the " Change Current/Power Buttons" box in the "GPIO Detail" section in the "I/O" window are used for the Rotary Encoders.

9.2.1.1 Encoder Recommendations

Meerstetter Engineering has tested the following encoders which fulfill the aforementioned requirements.

Manufacturer P/N	DigiKey P/N	Resolution
TT BI EN11-HSM1AF15	987-1188-ND	20 Pulses per Revolution
Bourns PEC11R-4215F-N0024	PEC11R-4215F-N0024-ND	24 Pulses per Revolution
Panasonic EVE-WRHJR012B	P15917-ND	12 Pulses per Revolution

9.3 Cooling Fans

Up to two fans can be connected and controlled by the device. The "Fan Control Feature" is intended to keep the temperature below a specified temperature, by using the slowest fan speed possible. This can be used to cool the LDD itself. Please refer to chapter 9.1 on how to configure the fan control signals.

9.3.1 Fan Requirements

The "Fan Control Feature" is only compatible to fans with the following features:

- PWM control signal input to control the fan speed. The device generates a 25 kHz or 1 kHz PWM signal from 0 to 100%. 3.3 V voltage level.
- Optional, but recommended: frequency generator signal output (“Tacho”) which represents the rotation speed. The output should be an open collector output signal.

For the logic level voltage definitions of the LDD, please refer to the datasheet.

9.3.2 Fan Recommendations

To obviate the need for a separate power supply, it is recommended to use a fan with the same supply voltage as the LDD needs.

We have tested the following fans, which fulfill the aforementioned requirements. All fans stop (0 rpm) at 0% PWM signal.

Table 6: Recommended fans.

Fan	Manufacturer P/N	DigiKey P/N	Voltage [V]	Power [W]	Dimensions [mm]		
					L	H	W
1	FFB0424VHN-TZT4	603-1818-ND	24	2	40	40	28
2	AFB0624EH-SP50	603-1803-ND	24	6	60	60	25
3	PFB0824DHE-YDG	603-2028-ND	24	32	80	80	38
4	AFB1224EHE-EP	603-1735-ND	24	20	120	120	38
5	FFB0412VHN-TP03	603-1206-ND	12	2	40	40	28
6	AFB0612DH-TP11	603-1211-ND	12	10	60	60	25
7	EFC0812DB-F00	603-1159-ND	12	4	80	80	15
8	FFC1212D-F00	603-1789-ND	12	17	120	120	25
9	PF40281BX-000U-S99	259-1666-ND	12	11	40	40	28

9.3.3 Optimized Settings

The following values are optimal settings for the CHx Fan Speed Controller parameters in combination with the corresponding fan. The bypass option ("Bypassing Speed Controller") is used for fans with integrated speed controller, to disable the speed controller.

Table 7: Suggested fan settings.

Fan	0% Speed [rpm]	100% Speed [rpm]	Kp [%/rpm]	Ti [s]	Td [s]	Bypass
1	-	-	-	-	-	Yes
2	-	-	-	-	-	Yes
3	-	-	-	-	-	Yes
4	-	-	-	-	-	Yes
5	0	10000	0.005	0.5	0	No
6	0	10000	0.005	0.5	0	No
7	0	4200	0.005	0.5	0	No
8	0	4400	0.005	0.5	0	No
9	0	22500	-	-	-	Yes

9.3.4 Connecting the Fan to the Device

- If the fan supports the same supply voltage as the LDD, it is recommended to connect the fan's GND and VCC to the LDD's GND and VIN, respectively.
- If a separate power supply is used for the fan, make sure that the GND terminals of the power supplies are connected. Never leave the fan's GND unconnected when the fan is powered. Otherwise, the GPIOx pins may be destroyed.
- Assign the correct function to the GPIO signals (see chapter 9.1 GPIO Control Signals).
- The PWM input of the fan must be connected to GPIO5 or GPIO6, since only these outputs generate a PWM signal. As an example, you can configure the GPIO as follows:
  - Pin: GPIO5
  - Function: Fan PWM
  - Level Assignment: Positive
  - Hardware Configuration: OUT PushPull
- The frequency output signal of the fan can be connected to any of the GPIO signals. As an example, you can configure the GPIO as follows:
  - Pin: GPIO4
  - Function Fan Tacho
  - Level Assignment: Positive
  - Hardware Configuration: IN WeakUp

9.3.5 Control Function

The fan control feature uses two PID controllers.

The first PID controller sets the required cooling power depending on the temperature of the heatsink. In most cases only P control is used. We recommend a value of 30 %/°C for Kp. Thus, for a target temperature of 40 °C, the fan will rotate with 0% speed at 40 °C and 90% speed at 43 °C.

This required cooling power is then converted into a nominal fan speed. For example, if the minimum and maximum fan speeds are set to 1000 rpm and 11000 rpm, respectively, the required cooling power of 50% is converted into a nominal fan speed of 6000 rpm.

The second PID controller sets the fan speed by varying the PWM output signal until the nominal fan speed is reached.

The "Fan Speed Controller" should be set up before without temperature regulation of the heatsink. This can be done by setting both the "Target Temperature" and the "100% Speed" to a high value. This allows to use the "0% Speed" as a fixed rotation speed. The fan should reach the nominal speed as fast as possible.

It is possible to stop the fan by an external GPIOx signal. This is useful, e.g., if a door of a compartment is opened (see chapter 9.1 GPIO Control Signals).

If a hysteresis is needed the parameters "Min Speed Start" and "Min Speed Stop" can be used. If those values are set to zero, they will be ignored.

9.3.6 Fan Parameter Description

Table 8: CHx Fan Control Enable

Parameter Name	Options and Description
Fan Control Enable	• Disabled • Enabled: Enables the fan controller

Table 9: CHx Fan Temperature Controller

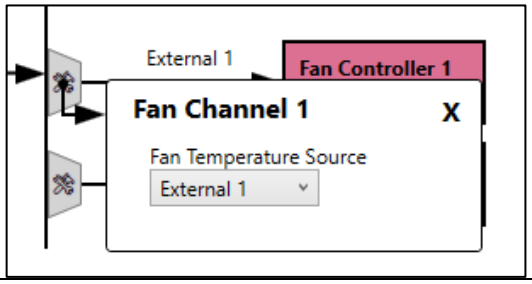
Parameter Name	Options and Description
Fan Temperature Source	The Actual Temperature for the temperature controller is taken from: • External 1: External Temperature Input 1 • External 2: External Temperature Input 2 • Device: Temperature of the LDD's output stage The assignment of the temperature source can be done in the main window in the following popups that lead to the "Fan Controller x" buttons: 
Target Temperature	Target temperature (set point) for the temperature controller
Kp, Ti, Td	PID controller parameters for the temperature controller

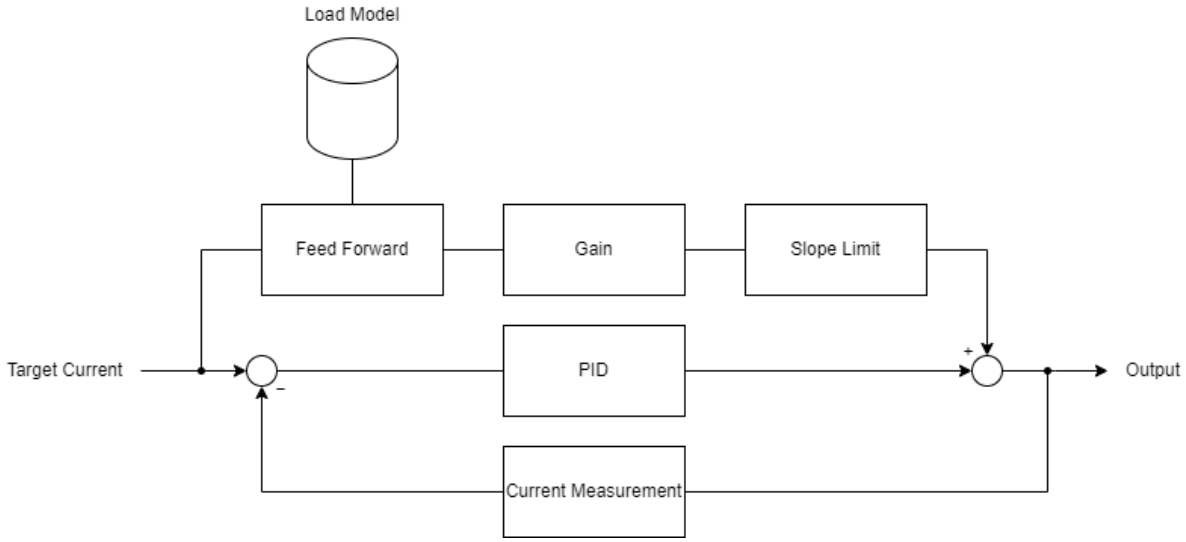
Table 10: CHx Fan Temperature Controller

Parameter Name	Options and Description
0% Speed	Minimum rotation speed
100% Speed	Maximum rotation speed
Min Speed Start	Minimal speed above which the fan is started
Min Speed Stop	Minimal speed below which the fan is stopped
Kp, Ti, Td	PID controller parameters for the Fan Speed Controller
Bypassing Speed Controller	• Yes: Disables the Fan Speed Controller. "Relative Cooling Power" is written directly to the PWM output. • No: The built-in speed controller is used.
Fan Surveillance	Disables Error 175 (`ERROR_FAN_CONTROL_LIMIT`) and Error 176 (`ERROR_FAN_BLOCKED`) This can be used when no tachometer signal is available.

10 Feedforward Control

By means of a measured voltage-current-curve, the required output for a requested target current is predicted. The predicted output is immediately applied, which is faster than a PID control loop iterating to the correct output level.

Please read the chapter 10.6 Feedforward Pitfalls before using this feature.



10.1 Load Modeling and Feedforward Prerequisites

This feature requires a software license and a load characterization in CW mode to use. See chapter 1.4 Licenses for more information about the software license.

10.2 Load Modeling and Feedforward Introduction

For use cases where a very fast rise time is required (<100 µs) it might be necessary to use the much faster feedforward in combination with the PID regulation. In the conventional operation mode the PID is responsible for reaching the initial set point and keeping it stable. The feedforward provides a faster controlling mechanism for highly transient set point values. Instead of slowly making its way up to the set point value, the feedforward requires a previously characterized curve of the load connected to the driver to determine the immediate output signal that needs to be applied. This is a trade-off between flexibility and speed. When used, replacing the LDD or the diode requires a new characterization. Different operating conditions may also require a new characterization.

10.3 Load Model Configuration

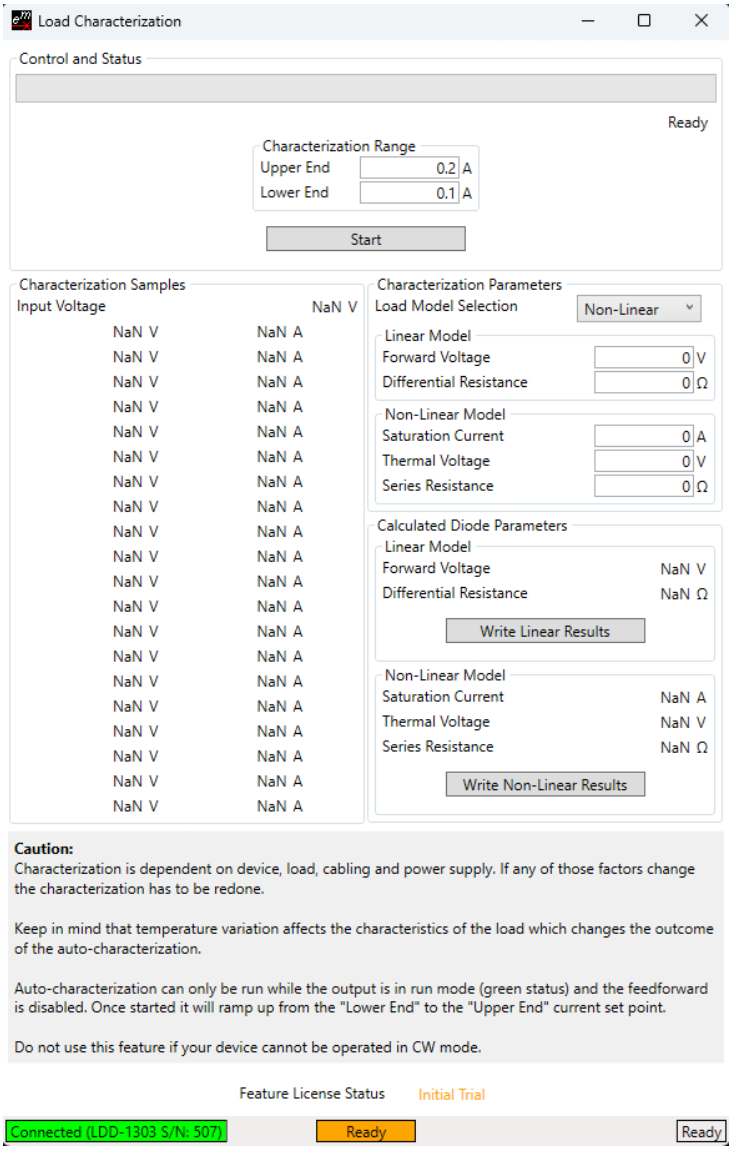


Figure 39: Load Characterization window

To use the feedforward the load model parameters have to be set first. To do so you have to run the auto-characterization. The only values that end up being used by the feedforward are either the two parameters of the linear model or the three parameters of the non-linear model depending on which load model is selected. The upper and lower end characterization parameters are only used during the auto-characterization.

10.4 Auto-Characterization

10.4.1 Auto-Characterization Prerequisites

Before starting, please be aware that the auto-characterization process applies a constant wave current to the diode. If your diode cannot operate in CW mode, you cannot use the auto-characterization. In this case, please contact us: support@meerstetter.ch

Furthermore, editing the model parameters manually is not recommended, except for inputting previously calculated values. Also, be aware that the model does not account for dynamic deviations, this is still done by the PID controller.

10.4.2 Auto-Characterization Range

It is recommended to characterize the full operating range you intend to use, however, the model might be able to extrapolate from a partial range as long as the modeling range sufficiently captures the characteristics of the diode. In other words, the model is most accurate when it properly captures the diode characteristics and the full application range.

Set the modeling range by changing the upper and lower end parameters in the “Load Characterization” window.

10.4.3 Auto-Characterization Step-by-Step

Before starting the auto-characterization, make sure that:

- The LDD is properly set up and that you can drive it to an arbitrary set point.
- The modeling range is set correctly.
- The modeling enable is turned off (requires reset).

Please read the chapter 10.6 Feedforward Pitfalls before using this feature.

Once you have ensured that all conditions above are met, turn on the output and then press the start button in the “Load Characterization” window. If an error occurs at any point, follow the error instructions displayed in the configuration software. Other than that, the auto-characterization should slowly progress, waiting a few seconds at each of the total 20 samples. The samples are displayed as they are gathered. Once the characterization status declares its completion, calculated values should be available and can be applied by pressing the “Write Linear Results” or “Write Non-Linear Results” button depending on which model you intend to use (more information below). Once this is done you can use the feedforward.

However please note, the modeling parameters are very sensitive to changes in the operating conditions. Special care must be taken to ensure that the following do not vary too much:

- Input voltage
- Load temperature
- Driver temperature

Please do not change the input voltage once the output is enabled. The input voltage is assumed to stay the same once the output is driven. Consider that using power cables that are too long and/or thin can lead to variation in the input voltage at increased output power levels.

There are two models available, the linear one and the non-linear one, both referring to the characteristics of voltage versus current. Usually, you want to use the non-linear, which is the one used for diodes. The linear one is meant for linear loads like resistors.

The linear model parameters only apply when the linear model is selected, likewise, the non-linear model parameters only apply when the non-linear model is selected.

The samples and the driver input voltage at modelization are stored within volatile memory until the next reset, while the model parameters are stored in persistent flash memory. A new characterization is required when changing the input voltage by more than approximately 5%, otherwise the accuracy of the feedforward might be negatively affected.

10.5 Feedforward Configuration

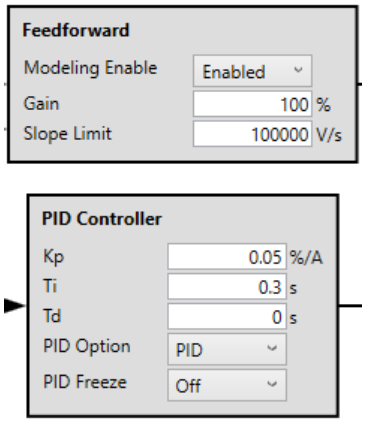


Figure 40: Feedforward Configuration

Modeling Enable
This parameter specifies whether the feedforward is used, if disabled the feedforward and diode model are not used. When enabled, none of the regular PID settings are used, including the slope limit. “Modeling Enable” must be disabled before starting a new auto-characterization. This parameter requires a reset for changes to take effect.

Gain
Only change the gain if changing the slope limit does not yield the desired results. Gain scales the output of the feedforward before it is applied. Gain can be 100% with low inductivity/low capacitive loads (should not have any overshoot) otherwise a value slightly below 100% may be better. It is generally a good idea to work your way towards the optimal settings in slow incremental steps. Keep in mind the gain defines the output voltage in percent, use smaller steps on high voltage outputs.

Slope Limit
Make sure to not set the slope limit too high. The slope limit is the main parameter to change to avoid overshoots of the feed forward. The slope limit is defined in volts per seconds instead of ampere per seconds like the regular slope limit. The reason for that is because the feedforward, unlike the PID, does not operate on the basis of feedback from the current measurement which is what makes it a lot faster. The default 100000 volts per second might be too slow or too fast depending on your use case. This is equal to 1 volt per 10 µs. To reach 20 volts this would take 200 µs, which is quite slow in terms of feedforward speed. The feedforward can usually achieve risetimes below 100 µs, in optimal situations even below 10 µs (some overshoot might occur). In fact, depending on the load, 200 µs risetimes are achievable using the regular PID controller.

PID Kp, Ti and Td
The PID parameters of the feedforward behave just as the regular PID parameters, refer to chapter 3.2.2 Current Controller Settings for more information. Please note that you cannot just copy the normal PID parameters for feedforward operation, usually the feedforward PID has to be much slower since it starts at approximately the forward voltage of the diode load and should only be used to balance out the dynamic deviations in the system (e.g. temperature).

Please note that it is not advisable to use a fast PID parameter set with the feedforward system. The PID is supposed to even out small errors since the feedforward already moves the output to the forward voltage of the load.

PID Option
Due to implementation details of the PID regulation, setting K_p to zero is not possible. Instead this option provides a way to use a pure I controller which can be useful in combination with the feedforward regulation.

PID Freeze
By default the PID (or I) controller always runs when the output is enabled. This may not be desirable depending on how the feedforward is used. In case the PID controller is enabled during a steep slope it is possible that it oversteers causing an overshoot (the PID acts on top of the feedforward). This can be prevented by freezing the PID while the feedforward is actively changing the output level. This parameter has 3 options. Off, to always run the PID, On, to disable the PID during the feedforward phase, and reset. The last option resets the PID to its initial state in addition to freezing while the feedforward output is changing. This is useful for example when operating a square wave and the PID state during the low phase cannot be applied during the high phase.

10.6 Feedforward Pitfalls

When compared to regular PID operation, using the feedforward PID is harder and more error prone. To mitigate the risk of causing damage (to the load, the LDD is pretty resilient and well protected) you should carefully read the user manual before configuring and operating the feedforward, and understand the feature using a test load.

The accuracy of the feedforward depends on the exact repeatability of the operating conditions of the device. This also includes the operating temperature of the load. A possible mistake is characterizing the diode load in a cold state right after powering up. It is advisable to run the auto-characterization at roughly the same temperature as it will run in real operation. A hot diode usually draws more current at lower voltages. This means:

Condition	Result
Diode runs hotter in use than during characterization	Feedforward too high: overcurrent possible
Diode runs colder in use than during characterization	Feedforward too low: may not achieve required risetime

Since the feedforward regulation brings the LDD and the circuitry surrounding it to its limits, it is important to consider proper wiring. The inductance and stray capacitance in the laser current path is going to oppose and slow down every change in current initiated by the LDD, this can lead to overshoot issues when using the feedforward. For this reason, make sure to keep wire length short and twist the wires to minimize inductance.

10.7 Feedforward FAQ

10.7.1 Signal Generator couldn’t reach low value

This might happen if you characterized the diode in a cold state. In this case the feedforward might apply a higher voltage to achieve the desired current since the characterization curve will be slightly too high.

If you are not satisfied with the results of the feedforward it is recommended to first rerun the characterization before tuning the PID. Tuning the PID is error prone and could lead to damage of your laser diode. Furthermore, it is important to note that you cannot just copy the PID settings you have used without the feedforward as they are most likely too fast, this is why there are separate settings.

10.7.2 Pulsed Auto-Characterization

No pulsed auto-characterization is available at time of writing this, if this is a feature you are interested in because the alternatives are not viable for you then please contact us (support@meerstetter.ch) so we can evaluate whether there is demand for this. Some diodes allow characterization at lower currents in CW, the extrapolated data might be usable, given the right model is selected, usually non-linear when working with diodes.

10.7.3 Characterization Invalid

In some cases, the LDD will show a characterization warning. If this occurs increase the modeling range and try again. In case of a negative series resistance the calculated values are still available, but the resulting load model might not be accurate, especially outside of the characterized range.

11 Troubleshooting and Errors

11.1 Quick Reference

Table 11: Typical Problems

Problems	Possible Reason	Possible Solution
The Configuration Software is not starting.	The required .NET Desktop Runtime is not installed on the system.	Make sure that you have the .NET Desktop Runtime installed on your system. See Download .NET (microsoft.com).
The output is suddenly switched off.	An error happened.	Check the error message.
The firmware is too old.	The firmware is too old to connect to the Configuration Software.	Please update the firmware as described in 2.4 Firmware Updates .
Error 105 shows up while the output current is rising.	1303: The input voltage is insufficient to reach the voltage necessary to drive the target current. 1301: Possibly Hardware Damage	Check if the voltage requirements on the datasheet are respected and ensure that the output power of your supply is sufficient to avoid voltage drops.
Error 103	• The input voltage is insufficient. • The PID controller is set up too aggressively or incorrectly.	
Error 102	Load with too low compliance voltage is used or short-circuit at output.	Check Load for short-circuit or use load with higher compliance voltage.

11.2 Error Numbers, Instances and Parameters

- Error Numbers from 1 through 99, excluding 30 through 39, designate error conditions that are universal across the whole range of Meerstetter TEC controllers and laser diode drivers.
  Error numbers starting from 100 designate conditions that are specific to LDD-130x devices (see tables below).
- Error Instance can designate the involved instance of a functionality or be useful information for Meerstetter Engineering technical support.
- Error Parameters are additional information to help Meerstetter Engineering technical support in the process of error diagnosis or remote debugging.

11.2.1 Error Numbers 1 – 99 (universal)

Table 12: Processor Errors

#	Description	Error Condition
1-10 13-15	MCU system malfunction	-

Table 13: HMI Errors

#	Description	Error Condition
11	Emergency stop was triggered by LTR-1200	-
12	LTR-1200 HMI regularly sends 'free' signals to all rack-internal devices such that they can activate their output stages (if enabled)	No signal received for more than one second

Table 14: Parameter System Errors

#	Description	Error Condition
22	Parameter set corrupt	Configuration flash empty or defect (fix: see error #23)
23	Parameter set incompatible with current firmware version	Load .xml file saved prior to FW update, or Default.xml
24	Firmware does not recognize valid device	-
25	Internal parameter system malfunction	Access to a non-existing instance
26	Internal limit system malfunction	-
27	Parameter write or read wrong datatype function used	-
28	Parameter write value out of range	-

Table 15: Power Supply Errors

#	Description	Error Condition
30	Input voltage net too low	< 10.5 V
31	Input voltage net too high	> 63 V (for HW version ≥ v1.20) > 55 V (for HW version < v1.20)
32	Internal 12 V power net too low	< 10.7 V
33	Internal 12 V power net too high	> 13.5 V
34	Internal 5 V power net too low	< 4.7 V
35	Internal 5 V power net too high	> 5.25 V
36	Internal 3.3 V power net too low	< 3.1 V
37	Internal 3.3 V power net too high	> 3.5 V
38	Internal −5 V power net too low	< −6 V
39	Internal −5 V power net too high	> −4 V

Table 16: Flash Memory Errors

#	Description	Error Condition
50	On-board flash failure	Write Timeout
51	On-board flash failure	Erase Timeout
52	On-board flash failure	Invalid Address

Table 17: Communication Error

#	Description	Error Condition
53	UART send buffer overflow error	-
54	CANopen internal error	-

Table 18: Device Temperature and Hardware Errors

#	Description	Error Condition
60	Device running too hot	See datasheet.
61	Communication error with I/O hardware during factory test	-

11.2.2 Error Numbers 100 - ... (specific to LDD-130x devices)

Table 19: Power Output Errors

#	Description	Error Condition
100	Output overcurrent	> “Current Error Threshold”
101	Output overvoltage	> “Voltage Error Threshold”
102	PID lower limit error	Too long in lower limitation (0, 0.1 % margin) and Output current > 0.25 A
103	PID upper limit error	Too long in upper limitation (0.96, 0.1 % margin)
104	Fast switchoff output overcurrent error	Device overcurrent
105	Input overcurrent	> 57 A, > 500 ms
110	Interlock error	Interlock low If you are not using the interlock connector, this function can be disabled via the DIP switch.

Table 20: Current Measurement Errors

#	Description	Error Condition
120	Phase current measurement offset too high.	-
121	Phase current measurement offset too low.	-

Table 21: Internal Power Stage Errors

#	Description	Error Condition
130	Excessive phase asymmetry	-
131	Measured and calculated output currents too different	-

Table 22: External Temperature Measurement Errors

#	Description	Error Condition
140	12 bit ADC raw value below safety margin	< 40 (1%)
141	12 bit ADC raw value above safety margin	> 4050 (99%)
142	Measured temperature too low	< “Lower Error Threshold”
143	Measured temperature too high	> “Upper Error Threshold”

Table 23: Load-Characterization Errors

#	Description	Error Condition
150	Auto-characterization failed: Could not reach the target current in the given time frame.	-
151	Auto-characterization failed: The output must be enabled.	-
152	Auto-characterization failed: Modeling Enable must be turned off.	-
153	Auto-characterization failed: Upper end of the modeling range must be higher than the lower end.	-
154	Auto-characterization warning: Invalid non-linear model. Only the linear model has been calculated.	-
155	Auto-characterization warning: Series resistance calculation yields a negative value. The resulting non-linear model might be inaccurate.	-

Table 24: Feature Unlock Errors

#	Description	Error Condition
160	LPC feature locked: Load a valid license or disable LPC.	-
161	Feedforward feature locked: Load a valid license or disable the feedforward.	-

Table 25: Fan Control Errors

#	Description	Error Condition
175	The fan does not reach the desired rotation speed.	Fan PWM Signal is 100% and the reached Speed is < 60% of the nominal speed for 12 s
176	The fan does not rotate.	Fan Speed = 0 and PWM Level > 35% for 10 s

Table 26: Various Errors

#	Description	Error Condition
183	No package has been received within the specified watchdog timeout time	-
188	Reset required	Some essential settings are only applied during startup. Please reset the device.

A Change History

Date of change	Version	Changed/ Approved	Change / Reason
20 December 2021	A	RS/HS	• Initial Release
1 April 2022	B	HS/PV	• Error 102 edited • Describe temperature correction function
29 August 2022	C	CU/RS	• Describe the theory of light power control • Light Measurement edited
6 September 2022	D	CU/RS	• Chapter 3, 4 and 5 edited (add auxiliary pictures, detailed text descriptions) • Chapter 6, 7 and 8 edited (auxiliary pictures added)
23 September 2022	E	ML/CU	• Add CANopen to the overview picture • Add Capture 2.2.3 CANopen
15 March 2023		CU/RS	• Document and firmware version updated • Picture of the CANOpen interface added • Picture of the power controller settings updated and the unit of the PID Kp value corrected in chapter 4 • Error condition of the error number 31 corrected to 63V for the newer HW versions • Quick References restored because confused information was included • Pictures new updated
25 June 2024	F	SC/RS	• Add: Signal Generator section • Add: Lookup Table section • Mod: GPIO function list updated • Add: Cooling Fans section • Mod: removed all mentions of volatile parameters
16 October 2024	G	SC/RS	• Removed all mentions of the GPIO option for the Output Enable. • Removed “static” terminology where it no longer applies.
27 February 2024	H	SC/RS	• Add: Feedforward/Load Modeling section • Add: Feature Unlock section • Upd: Error List
6 May 2026	I	SC/NJ	• Add: GPIO Node ID function description • Mod: Adjusted for the new Configuration Software • Del: Advanced Output Limits Configuration section