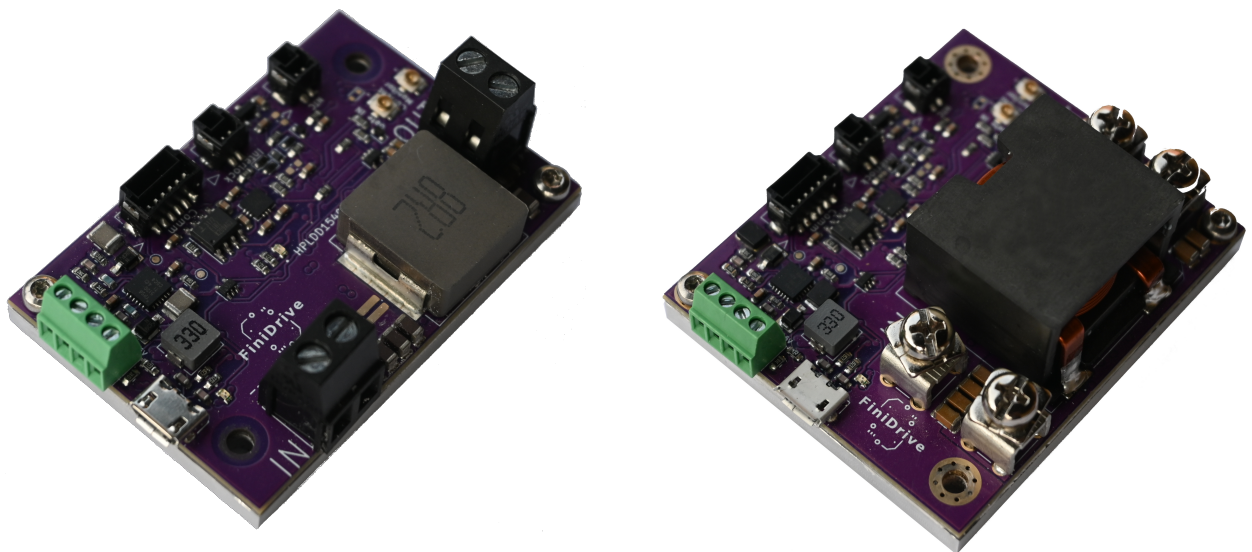




# HPLDD User Manual

For HPLDD1540 and HPLDD3040

Version 1.0



FiniDrive  
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# Chapter 1

## Introduction

The HPLDD family is a compact high power laser diode driver platform designed for applications that require both fine current control and robust protection. In the current documentation set this manual covers two closely related models: HPLDD1540 and HPLDD3040. Both share the same operating concept, communication model, protection philosophy, and connector logic.

The devices are intended for laboratory setups as well as OEM integration. In practice they can be used in systems ranging from small laser diode loads around 1 W up to model-specific high-power configurations: up to approximately 600 W for HPLDD1540 and up to approximately 1200 W for HPLDD3040, as long as the operating point stays within the electrical limits of the selected model. This wide useful range is one of the core practical advantages of the platform.

Key platform characteristics include:

- input voltage range from 10 V to 55 VDC,
- output compliance up to 40 V, with output voltage additionally limited to approximately 73% of input voltage,
- programmable output current up to 15 A on HPLDD1540 and up to 30 A on HPLDD3040,
- 1 mA protocol setpoint resolution across the family,
- programmable ramp-up and ramp-down rates from 0.01 A/s up to 600 A/s,
- USB, RS-232, and RS-485 communication,
- external gate input and analog current monitor output,
- compact mechanics, with only small footprint differences between the two covered models.

This manual is structured in three layers. The first part is user-oriented and focuses on safe startup and basic operation. The middle part explains the internal logic and interface behavior of the driver. The appendices provide a GUI quick manual and protocol reference material for system integrators and software developers.

## Model differences covered by this manual

Table 1.1: Main differences between the covered HPLDD models

Parameter	HPLDD1540	HPLDD3040
Maximum programmable current	15 A	30 A
Protocol setpoint resolution	1 mA	1 mA
Effective setpoint accuracy	1 mA	2 mA
Board footprint	40 mm x 60 mm	50 mm x 60 mm
Mounting hole spacing	25 mm x 50 mm	40 mm x 50 mm

# Chapter 2

## Safety Information

### 2.1 General laser safety

An HPLDD driver is only one part of a laser system. Safe use of the complete system always depends on the laser diode, optics, housing, power supply, interlocks, and the user's procedures. Follow the safety requirements applicable to the laser class of the final installation.

### 2.2 Electrical safety and startup precautions

Before powering the driver for the first time:

- verify that the driver is mechanically mounted in a way that provides adequate heat removal from the attached heatsink,
- verify power supply polarity and voltage,
- verify the laser diode wiring,
- verify that the interlock loop is closed,
- verify that an external NTC is connected if diode temperature supervision is expected,
- start with a zero current setpoint,
- use conservative current limits and ramp rates during initial testing.

The driver powers up with a current setpoint of zero. Even if the output stage is enabled and all gating conditions are satisfied, no current will flow until a non-zero setpoint is explicitly written.

### 2.3 Cooling and heatsink potential

The HPLDD driver is delivered as a PCB with an attached aluminum heatsink. The end user must provide an adequate thermal path from that heatsink to the final mechanical assembly, chassis, or cooling structure. Internal temperature supervision is a protection feature, but it is not a substitute for proper thermal design.

The heatsink is also part of the electromagnetic shielding concept of the product. It is electrically bonded to device ground through the mounting screws, so the heatsink sits at the same potential as IN-. Treat it as a grounded conductive part of the driver assembly, not as a floating mechanical accessory.

## 2.4 Important output-stage note

The laser output terminals are not referenced to system ground. Do not ground either output terminal. Treat the output pair as a dedicated current path between the driver and the laser load.

## 2.5 Interlock loop

The interlock loop is part of the hardware safety chain. In the current hardware revision the loop is no longer treated as a simple continuity input. Correct operation requires a minimum loop current of 4 mA, which corresponds to a maximum total loop resistance of 355 Ohm.

This protection is not implemented only as a software signal sent to the MCU. The interlock state is routed through hardware logic directly to the converter controller and to the crowbar path. As a result, if the interlock loop opens during operation, the driver does not merely report an error and stop regulating current. The output stage is shut down immediately and the OUT terminals enter a crowbar shorting state.

For safety reasons this behavior cannot be overridden by software or protocol commands. Any valid operating state always requires a physically closed interlock loop.

## 2.6 Temperature supervision

The driver supports two thermal supervision paths:

- internal driver temperature monitoring,
- external laser diode or laser module temperature monitoring through the NTC input.

Driver overtemperature protection is always part of the internal supervisory logic. The external diode-temperature path depends on the presence of an NTC sensor, the configured beta value, and the programmed temperature limits.

If internal driver temperature exceeds 80°C, the driver shuts the output down and reports a driver overtemperature error. This mechanism is intended as a last-resort protection layer and must not be used as the normal method of thermal management.

## 2.7 Current ramping and overshoot

The HPLDD family provides programmable ramp-up and ramp-down behavior. Using controlled ramps is strongly recommended during first startup and for sensitive laser loads. Setting a ramp value of zero requests an effectively instantaneous change. This can be useful in some tests, but it also reduces the margin against transient overshoot and should be treated carefully.

Figure 2.1 shows a measured 0–10 A current ramp configured at 600 A/s. The expected transition time is approximately 16.7 ms, and the oscilloscope capture shows a monotonic linear ramp into the final value without visible overshoot.

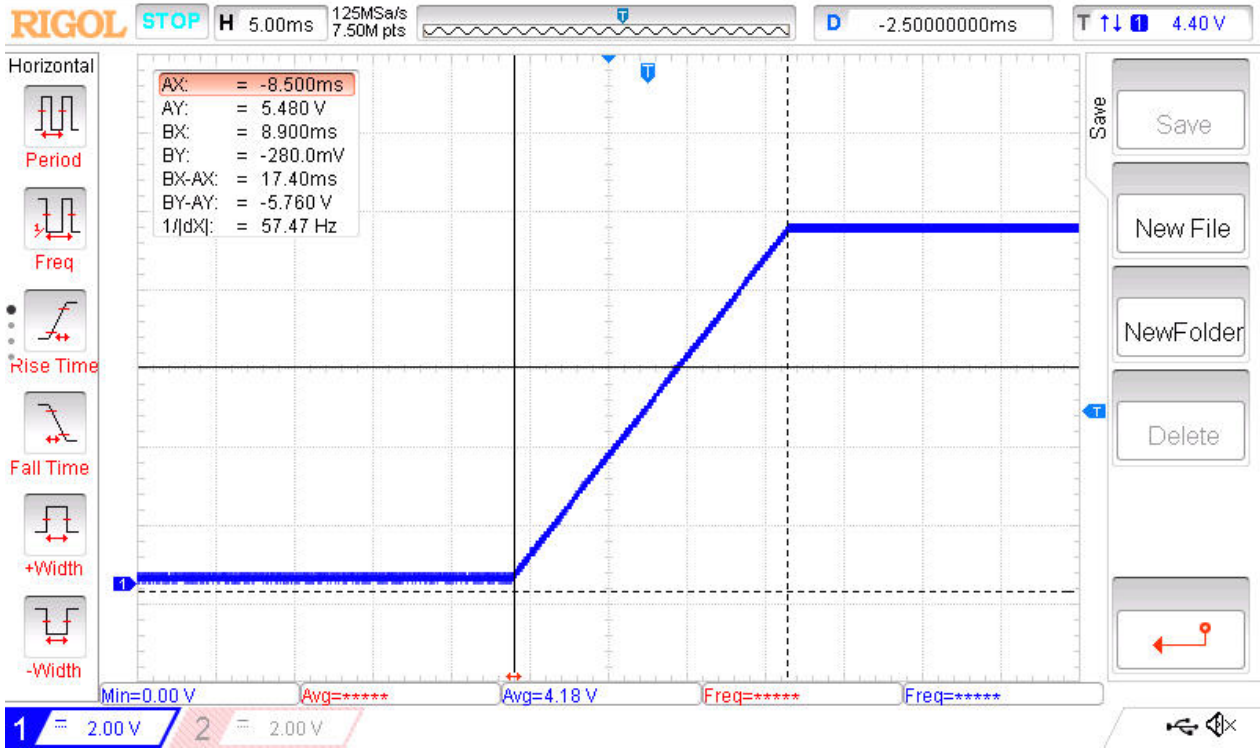


Figure 2.1: Oscilloscope capture of a 0–10 A current ramp at 600 A/s.

# Chapter 3

## Product Overview

### 3.1 What the driver does

At a high level, an HPLDD driver converts DC input power into a tightly controlled output current for a laser diode load. The actual current delivered to the load depends not only on the programmed setpoint, but also on the state of the internal gate, the external gate input, active protection logic, and thermal or interlock conditions.

### 3.2 Core electrical capabilities

Table 3.1: Family-level characteristics and model-dependent values

Parameter	Value or behavior
<b>Input voltage</b>	10–55 VDC
<b>Output voltage</b>	1–40 V, additionally limited to about 73% of input voltage
<b>Output current</b>	HPLDD1540: 0–15 A programmable HPLDD3040: 0–30 A programmable
<b>Current setpoint resolution</b>	1 mA command resolution on both models
<b>Effective setpoint accuracy</b>	HPLDD1540: 1 mA HPLDD3040: 2 mA
<b>Current monitor output</b>	HPLDD1540: 0–15 V for 0–15 A, 1 V/A HPLDD3040: 0–15 V for 0–30 A, 0.5 V/A
<b>External gate input</b>	3.3 V logic level input
<b>Communication interfaces</b>	USB, RS-232, RS-485
<b>Board footprint</b>	HPLDD1540: 40 mm x 60 mm HPLDD3040: 50 mm x 60 mm
<b>Mounting hole spacing</b>	HPLDD1540: 25 mm x 50 mm HPLDD3040: 40 mm x 50 mm

### 3.3 Protection and control features

The driver combines several independent control and protection layers:

- programmable current setpoint,
- programmable current ramp-up and ramp-down,

- hardware overcurrent cut-off using a comparator threshold,
- internal and external temperature supervision,
- interlock loop supervision,
- optional load sensing,
- status and error reporting over the communication interface,
- crowbar behavior when the output stage is disabled.

### **3.4 Typical applications**

Typical use cases include:

- laboratory current driving of laser diodes and laser modules,
- OEM optical subsystems requiring repeatable current ramps,
- CW and QCW systems using digital or external gate control,
- installations where software access, monitoring, and interlock support are required.

# Chapter 4

## Working Principle

### 4.1 Functional overview

Figure 4.1 shows the high-level power path, control path, and external interfaces shared by the HPLDD1540 and HPLDD3040.

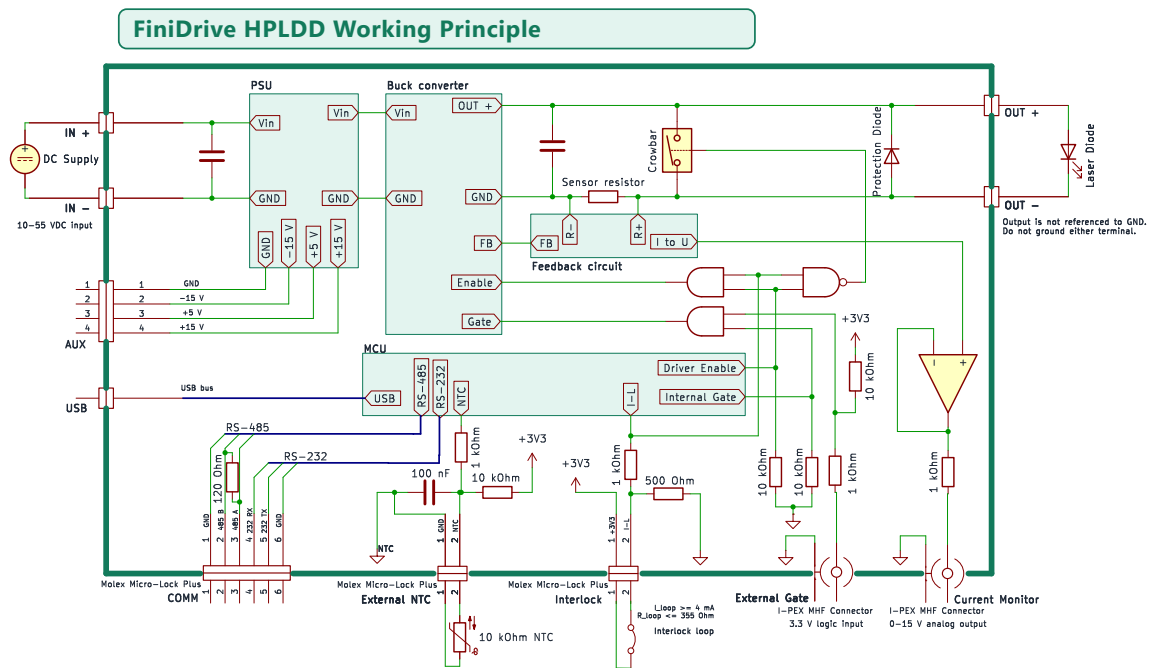


Figure 4.1: HPLDD family functional scheme

The power input feeds the main buck converter. The converter is supervised by the MCU, which manages the user-visible setpoint, ramp generation, measurement acquisition, status logic, and communication. The output current is controlled through an internal transient-current target that moves toward the requested setpoint according to the programmed ramp parameters.

## 4.2 Transient current and measured current

One of the most important concepts in the HPLDD family is the distinction between three related quantities:

- **final current setpoint** - the user-requested target current,
- **transient current** - the internal current target currently generated by the ramp logic,
- **measured current** - the real current flowing through the load.

When the user changes the setpoint, the firmware does not instantly jump the internal target unless ramping is disabled. Instead, it moves the transient current toward the requested target using the programmed ramp-up or ramp-down rate. This is why the protocol exposes both the final setpoint and the current transient target.

Measured current becomes non-zero only if all enabling conditions are satisfied and no protection condition blocks the output path.

## 4.3 Gating logic

Output current becomes active only when all of the following conditions are met:

- the driver is enabled,
- no active error blocks operation,
- the internal gate is high,
- the external gate input is high or left disconnected through its pull-up behavior.

As shown in the functional scheme, the converter is gated through a logical AND stage. One AND input comes from the MCU and represents the *internal gate*. The second input comes from the external gate connector. Both conditions must be logically high for the converter to be allowed to switch.

This has an important practical consequence. If nothing is connected to the external gate input, or if it is connected to a high-impedance source, the external gate line is pulled up to 3.3 V through a 10 kOhm resistor. In that case the external gate path defaults to logic high and the converter is effectively controlled only by the MCU-side internal gate.

If any of these conditions is not met, the driver can still internally update the transient current target, but the measured output current remains zero.

## 4.4 Status indicators

The firmware exposes several useful runtime status bits:

- **ENABLED** - output stage enabled,
- **GATE** - internal gate high,
- **READY** - enabled with gate low,
- **AT SETPOINT** - transient current has reached its target,

- **RAMPING** - transient current is still moving,
- **POWERGOOD** - measured current is within the defined band around the set current,
- **LOAD\_SENS** - load sensing enabled,
- **TEMP\_MON** - external temperature monitoring enabled.

Two practical caveats are important here. First, load sensing is generally not useful when the driver is intentionally gated from the external gate input. In that mode the user may deliberately suppress output current while the driver still expects current according to its internal state, so the firmware can legitimately raise a no-load related error even though the behavior was commanded externally. In the current firmware, no-load checking becomes active when the transient current target is at least 1 A and measured current is still at or below 0.5 A. Second, **POWERGOOD** should be interpreted as a meaningful indicator only in CW operation. In externally gated or pulsed operation the measured current may be absent or intermittent by design, so **POWERGOOD** can appear false even when the system is behaving exactly as intended. There is no separate hard lower-current threshold for **POWERGOOD** in firmware, but for set currents below roughly 1 A it should still be treated cautiously because of low-current non-linearity and measurement quantization.

## 4.5 Protection behavior

Protection behavior is layered. Some faults are handled in hardware and some are the result of firmware supervision. In practice the user should treat all of them as conditions that require review before re-enabling the output.

Examples:

- overcurrent protection uses a hardware comparator and reacts essentially immediately,
- interlock errors force the output off if the loop opens during operation,
- driver overtemperature disables the output and raises an error flag,
- diode overtemperature depends on the external NTC path and programmed thresholds,
- no-load protection can trip if the driver expects current but does not detect a load.

No-load behavior also needs to be interpreted together with compliance voltage. The HPLDD family uses a buck converter, so it can only step voltage down from the input and cannot boost it above what the supply allows. If the planned load requires more forward voltage than the available input can support, the driver may drive the converter to its maximum available output voltage and still see almost no current. A typical example is a laser load expected to operate near 30 V while the driver is powered from only 24 V. In that situation the converter has no headroom to reach the required operating point, measured current can remain near zero, and the firmware may report a no-load condition even though the real issue is insufficient supply voltage for the intended load.

# Chapter 5

## Connectors and Pinout

### 5.1 Overview

The HPLDD1540 and HPLDD3040 expose power, communication, monitoring, and safety connections through dedicated connectors. The tables below are intended for practical integration work. For a system-level view refer to the functional scheme.

### 5.2 Top-side connector orientation

The reference photos below mark the pin-1 side of the numbered board-edge connectors.

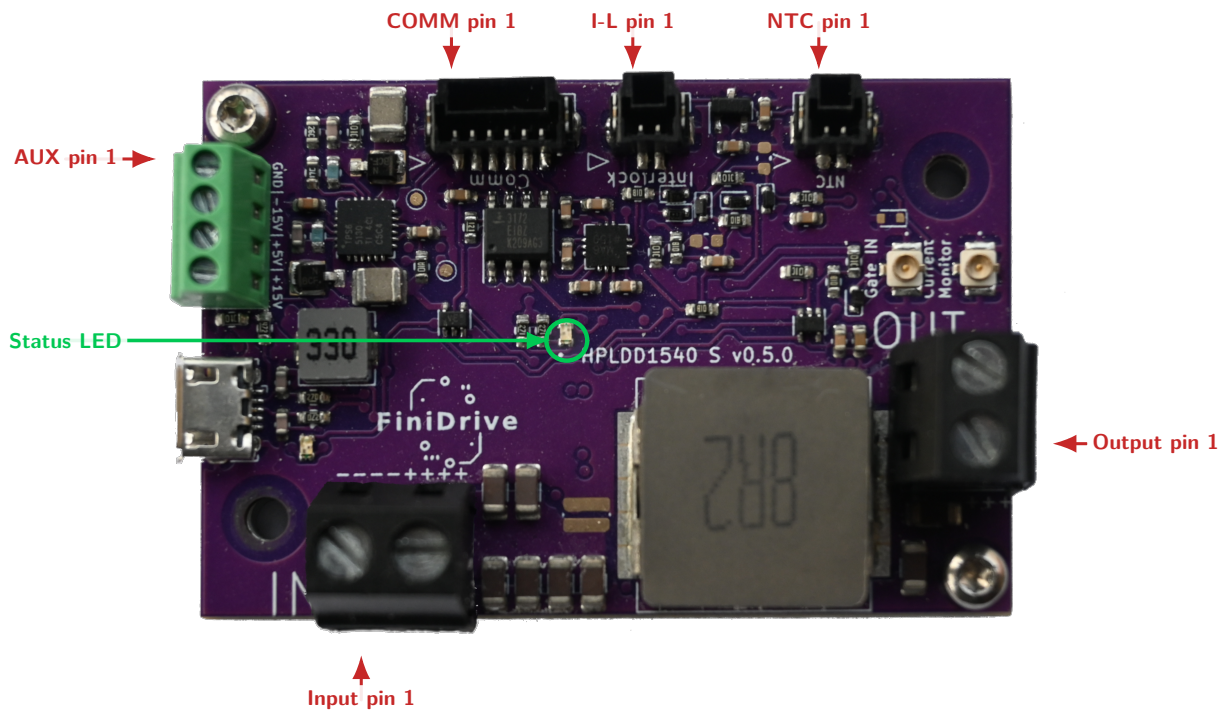


Figure 5.1: HPLDD1540 top-side pin-1 and status LED reference.

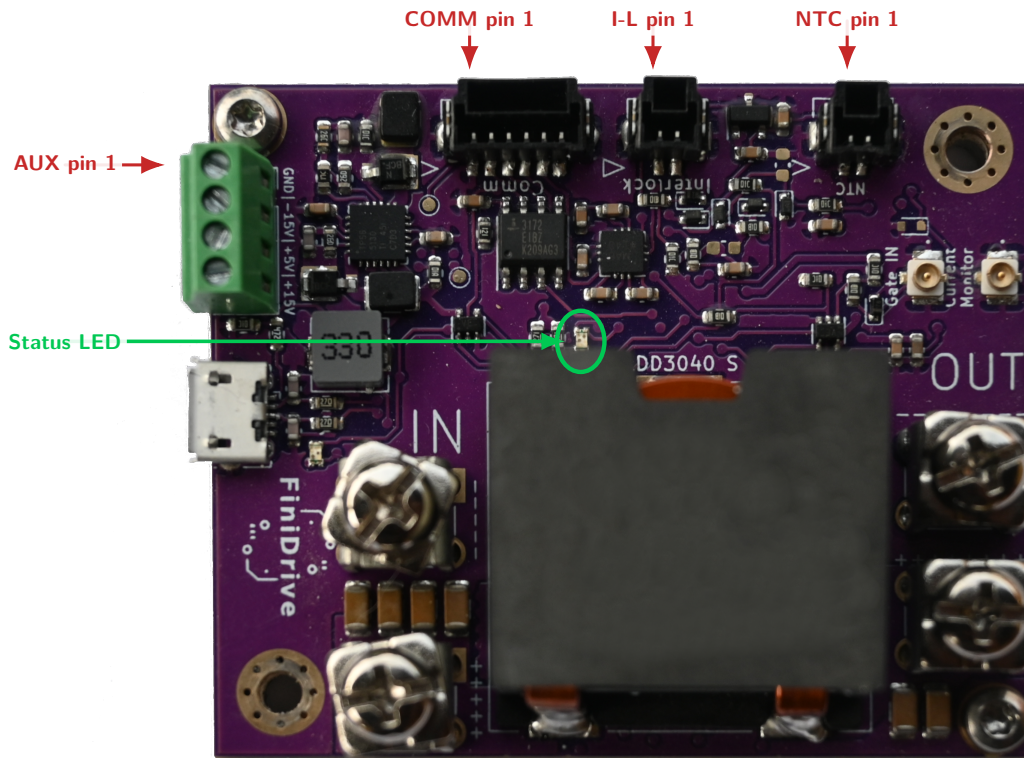


Figure 5.2: HPLDD3040 top-side pin-1 and status LED reference.

### 5.3 On-board LEDs

The board has two user-visible LEDs:

Table 5.1: On-board LED behavior

LED	Behavior
<b>Communication LED</b>	Located close to the USB connector. It blinks when communication with the driver is taking place through USB.
<b>Status / emission LED</b>	Located near the center of the board and marked in Figures 5.1 and 5.2. In the basic powered state it lights red. Red is used in many different non-enabled states and should not be treated as a detailed diagnostic code. The LED changes to green only when the driver is in the <b>Enabled</b> state. When this LED is green, the driver must be treated as being in a laser-emission-capable state, because optical radiation may be emitted from the connected laser diode. When the driver leaves the <b>Enabled</b> state, either due to an error or intentional disable action, the LED returns to red.

## 5.4 Power and output auxiliary connectors

Table 5.2: Power and output auxiliary connectors

Connector	Pin	Function	HPLDD1540 connector	HPLDD3040 connector
<b>Input</b>	1	IN-	2-pin screw terminal, AWG 22–12 wire	M4 ring-lug current terminal
	2	IN+		
<b>Output</b>	1	OUT+	2-pin screw terminal, AWG 22–12 wire	M4 ring-lug current terminal
	2	OUT-		
<b>Output AUX</b>	1	GND	Screw terminal, AWG 24–18 wire	Screw terminal, AWG 24–18 wire
	2	-15 V		
	3	+5 V		
	4	+15 V		

The Output AUX terminals provide auxiliary supply outputs that may be used when integrating the driver into a larger system. They are not driver power inputs.

## 5.5 Communication and safety connectors

Table 5.3: Communication and safety connectors

Connector	Pin	Function	Connector type
<b>COMM</b>	1	RS-485 GND	Molex Micro-Lock Plus
	2	RS-485 B	
	3	RS-485 A	
	4	RS-232 RxD	
	5	RS-232 TxD	
	6	RS-232 GND	
<b>USB</b>	Type	USB Micro-B, enumerates as COM port	USB Micro-B receptacle.
<b>NTC</b>	1	GND	Molex Micro-Lock Plus
	2	NTC input	
<b>Interlock</b>	1	+3.3 V	Molex Micro-Lock Plus
	2	I-L return	

## 5.6 Coax connectors

Table 5.4: Coax connectors

Connector	Function	Connector type
<b>External Gate</b>	3.3 V logic input	I-PEX MHF coax connector.
<b>Current Monitor</b>	Model-specific 0–15 V analog output: HPLDD1540 1 V/A, HPLDD3040 0.5 V/A	I-PEX MHF coax connector.

## 5.7 Practical notes

- Use wiring and mating hardware appropriate for the selected model. HPLDD1540 power terminals accept AWG 22–12 wire; HPLDD3040 current terminals are intended for M4 ring lugs.
- The NTC connector is intended for an external 10 k NTC sensor.
- The interlock loop must support at least 4 mA loop current and no more than 355 Ohm total resistance.
- The USB connector is the most convenient option for setup, diagnostics, and bench operation.
- RS-232 is useful for direct point-to-point integration.
- RS-485 is intended for addressed multi-device installations.

# Chapter 6

## Installation and Wiring

### 6.1 Power input

Use a DC supply within the specified 10 V to 55 V range. Verify polarity before energizing the system. The available output voltage is bounded not only by the absolute 40 V limit but also by the converter ratio, so practical maximum output voltage also depends on the selected input voltage.

### 6.2 Laser diode connection

Connect the laser load directly to the dedicated output terminals. Keep the current path short and deliberate. Avoid grounding either output terminal. When bringing up a new setup, start with a conservative current limit and a low setpoint.

### 6.3 Mechanical mounting and cooling

The supplied aluminum heatsink is the primary thermal interface of the driver. The final system must provide a real heat-removal path from that heatsink, for example through a metal baseplate, forced airflow, or another appropriately designed thermal interface. Do not assume that the small standalone heatsink is sufficient by itself at high current or high power dissipation.

Because the heatsink is bonded to ground through the mounting screws, it also acts as a highly effective electromagnetic shield. In electrical terms it is at the same potential as IN-. Keep that in mind when mounting the driver into conductive mechanical structures and when planning clearances around grounded metal parts.

The mounting holes are intended for M3 screws. Use hardware and tightening practice appropriate for a PCB-mounted power assembly with an electrically grounded heatsink.

### 6.4 Mechanical dimensions

The drawings below show the characteristic installation dimensions for the covered models. The top views show overall board length and width together with the spacing of the larger user-accessible M3 mounting holes. Other smaller holes visible on the board are used to fasten the PCB to the heatsink/base assembly and are not part of the user mounting pattern. The side views show the maximum assembly height used for mechanical clearance planning.

For HPLDD1540, height is measured from the bottom of the heatsink/base assembly to the top of the

IN and OUT terminals. For HPLDD3040, height is measured from the bottom of the heatsink/base assembly to the highest point of the main inductor.

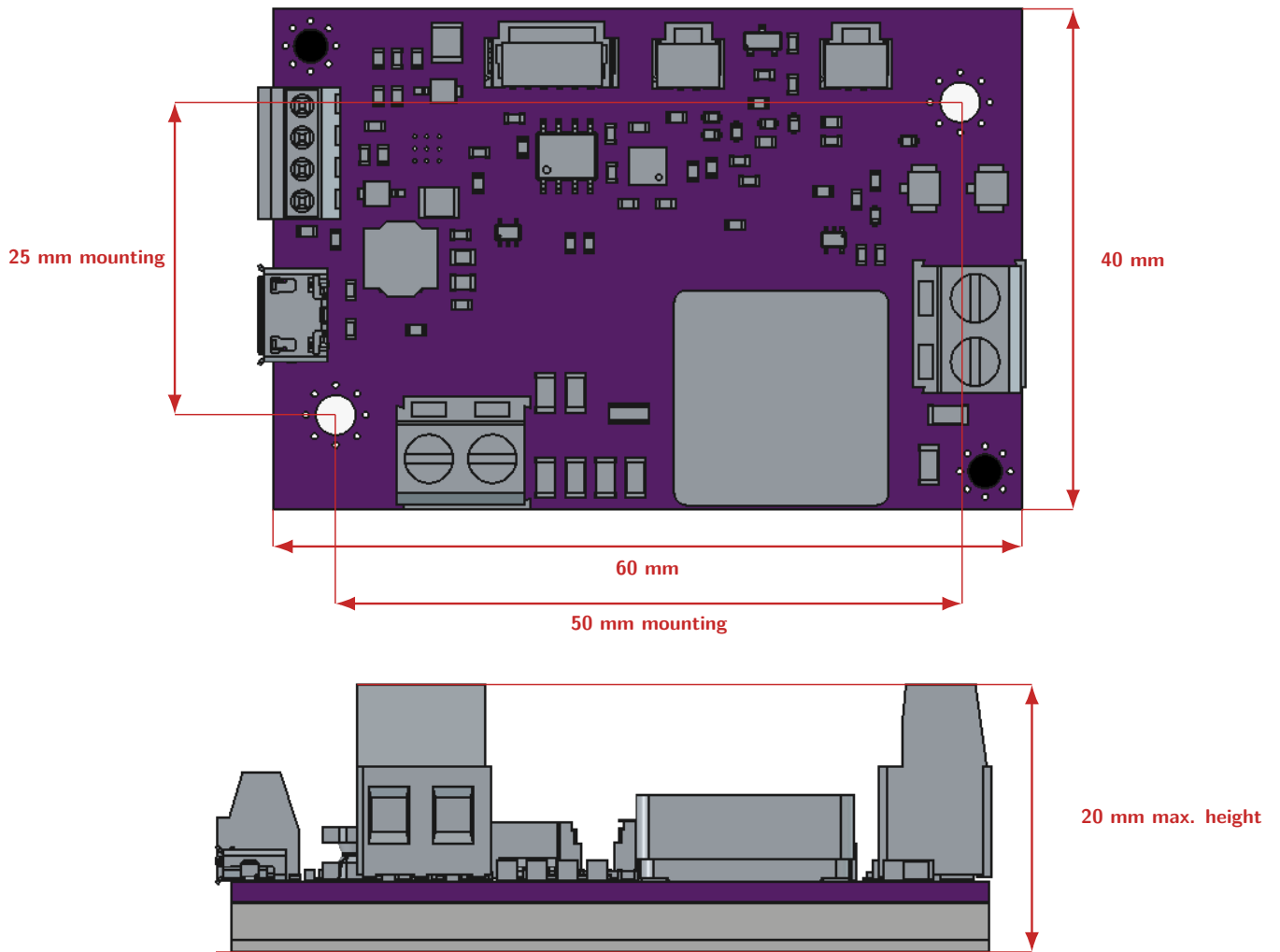


Figure 6.1: HPLDD1540 mechanical reference dimensions.

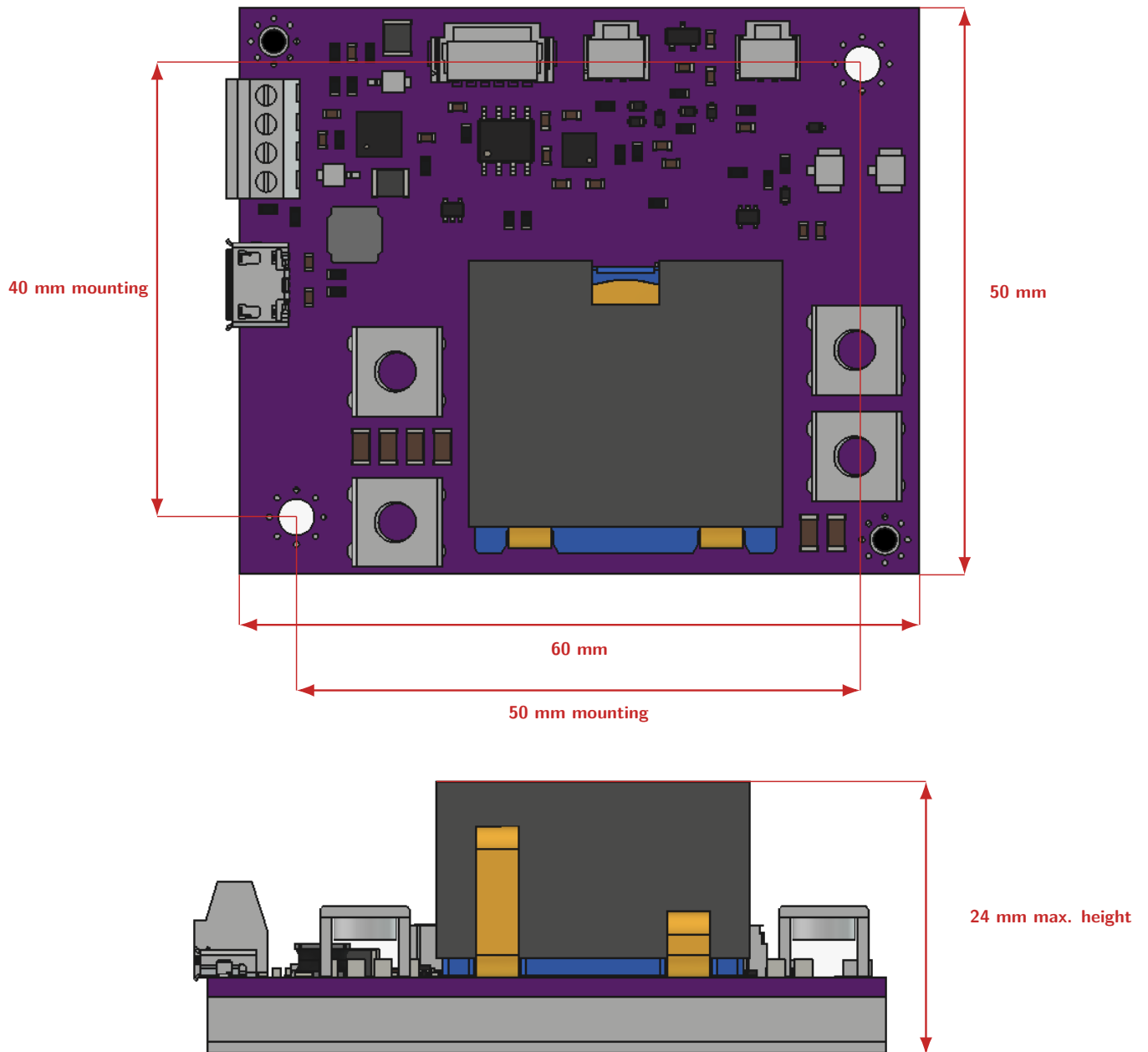


Figure 6.2: HPLDD3040 mechanical reference dimensions.

## 6.5 Interlock wiring

The interlock loop should be treated as part of the installation-level safety chain. If the loop opens while the driver is enabled, the output is shut down, the crowbar state is asserted on the OUT terminals, and an interlock error is raised. In this hardware revision the interlock input expects real loop current, not only dry continuity.

## 6.6 NTC wiring

If laser diode temperature supervision is required, connect an external NTC to the NTC input and configure the corresponding beta value and temperature limits in software. If the NTC path is not used, make sure the system design and operating mode reflect that decision.

## 6.7 Communication wiring

Three communication paths are available:

- USB for direct local use,
- RS-232 for direct serial integration,
- RS-485 for multi-drop networks.

Current firmware uses 115200 baud. The protocol can expose configuration bits related to communication, but in the current implementation 115200 baud is the effective operating speed.

## 6.8 External gate and analog monitoring

The external gate coax input accepts a 3.3 V logic signal. The current monitor coax output provides a model-specific analog representation of output current: 1 V/A on HPLDD1540 and 0.5 V/A on HPLDD3040. These ports are useful when the driver is integrated into a larger measurement or sequencing system.

# Chapter 7

## First Start and Quick Start

### 7.1 Recommended startup sequence

The following workflow is recommended for the first safe startup:

1. Verify power, output, interlock, and NTC wiring.
2. Connect the driver to a PC over USB.
3. Power the driver.
4. Launch the application, detect the correct COM port, and connect to the driver.
5. Read the basic device information and status.
6. Confirm that no error flags are active.
7. Set a conservative current limit appropriate both for the selected driver model and for the connected laser diode.
8. Set suitable ramp-up and ramp-down rates.
9. Enable live charts in the GUI.
10. Verify that the internal gate and external gate conditions are correct, but keep the driver disabled.
11. Change the current setpoint up and down in software, for example to 10 A and back to zero, and observe the plotted setpoint behavior. At this stage no output current can flow because the driver is still disabled.
12. Once the setpoint behavior is understood, explicitly return the setpoint to zero, enable the driver, and open the gate path if external gating is used.
13. Only then write a small non-zero current setpoint and observe measured current, measured voltage, and status bits.

### 7.2 What to expect

On a healthy setup:

- the setpoint starts at zero after power-up,
- enabling the driver alone does not guarantee output current,

- current appears only when the gate conditions are satisfied,
- the driver transitions through `RAMPING` before reaching `AT SETPOINT`,
- `POWERGOOD` becomes meaningful only after current has settled in `CW` operation,
- externally gated operation can intentionally suppress output current, so `LOAD_SENS` and no-load related behavior should be interpreted with care,
- below about 0.5 A the current response can be slightly non-linear relative to setpoint changes, so the first verification run should be treated as a behavioral check rather than a precision measurement.

### 7.3 Safe first values

For the first live test it is good practice to:

- use a small current setpoint,
- use moderate ramp rates rather than an instantaneous transition,
- keep the overcurrent threshold at least 0.2 A above the intended operating current,
- confirm the behavior of the interlock and gate chain before increasing current.

## Chapter 8

# Operating Modes and System Integration

### 8.1 USB single-device mode

USB is the simplest transport for direct use on a single device. The application exposes the USB connection as a COM port and is therefore the most convenient path for setup, diagnostics, and everyday bench work.

### 8.2 RS-232 single-device mode

RS-232 is suitable for point-to-point integration with a host controller or a larger machine. The protocol is the same command model used on USB, but carried through the serial interface. In bench use or diagnostic work the same mode can still be operated through the desktop application if the driver is linked to the PC with an external RS-232/USB converter.

### 8.3 RS-485 mode

RS-485 mode is intended for multi-drop systems. The current firmware supports device addresses from 1 to 32. Address 0 is reserved for broadcast discovery and cannot be assigned to a device.

The only supported broadcast operation is a discovery read of the RS-485 address command. Devices respond with a delay proportional to their address in order to reduce collisions.

The desktop application can still be used in this mode if the network is connected to the PC through an external RS-485/USB converter. This makes it possible to monitor and control multiple drivers from one workstation.

### 8.4 Persistence model

Configuration changes become active immediately at runtime, but they do not all survive a power cycle automatically. Use `SAVE_DATA` to store user-modifiable parameters in non-volatile memory. The current setpoint is intentionally not stored as an active current value for the next power cycle.

## Chapter 9

# Protections, Status, and Troubleshooting

### 9.1 Error sources

The main reported error conditions are:

- interlock error,
- overcurrent error,
- driver overtemperature error,
- diode overtemperature error,
- no-load error.

### 9.2 Typical troubleshooting cases

#### **Setpoint is non-zero, but measured current is zero**

Check the following in order:

- is the output wiring correct and is the load polarity correct,
- is the driver connected to a supply with enough voltage headroom for the intended load,
- is the driver enabled,
- is the internal gate on,
- is the external gate input high or safely left in its pulled-up state,
- is an active error flag present,
- is the interlock loop closed.

#### **Driver reaches setpoint internally but output behavior is wrong**

Compare transient current, measured current, and POWERGOOD. If transient current reaches the requested value but measured current does not behave as expected, the problem is typically outside

pure setpoint logic: gating, load wiring, load presence, compliance voltage, or protection behavior are better suspects.

### **Interlock error returns immediately after clearing**

This usually means the physical interlock condition is still invalid. Clearing the error flag does not override the live safety input, because the interlock path is enforced directly in hardware.

### **Temperature errors**

For driver overtemperature, inspect cooling, airflow, and the thermal interface between the attached heatsink and the final mechanical assembly. The internal protection trips at 80°C, so reaching this error indicates inadequate heat removal from the grounded heatsink assembly. For diode overtemperature, verify the NTC connection, beta setting, and the configured minimum and maximum temperature limits.

### **No-load error**

This usually indicates that the driver expected output current but the measured current did not match that expectation. Inspect the output path, the laser load connection, the load-sensing setting, and the available supply voltage. If the load needs more forward voltage than the available input can support, the buck converter may sit at its maximum obtainable output voltage while measured current remains near zero, which can still produce a no-load error.

# Appendix A

## GUI Manual

### A.1 Purpose and scope

The desktop GUI is intended for everyday setup, operation, monitoring, and troubleshooting of HPLDD drivers. The same operator workflow is used for USB, RS-232, and RS-485 connections; in RS-485 mode the application presents each detected driver as a separate device tab.

### A.2 Main window layout

Table A.1: Main GUI areas

Area	Operator use
<b>Connection</b>	Refreshes the COM port list, selects the communication port, and connects or disconnects the application.
<b>Device info</b>	Shows the connected driver's identification, hardware version, communication channel, and RS-485 address when applicable.
<b>Setpoints &amp; Limits</b>	Sets the requested current, current limit, ramp-up speed, ramp-down speed, and diode temperature limits.
<b>Measurements</b>	Shows measured current, output voltage, output power, driver temperature, diode temperature, and transient current.
<b>Control Switches</b>	Enables load monitoring, diode temperature monitoring, internal gate control, and the output stage.
<b>Status</b>	Shows live operating states such as enabled, gate, ramping, at setpoint, load monitor, power good, and diode temperature monitor.
<b>Error</b>	Shows active protection states. The <b>Clear errors</b> button clears latched error flags after the underlying cause has been removed.
<b>Charts</b>	Plots live current, temperature, voltage, and power values for visual inspection during operation.

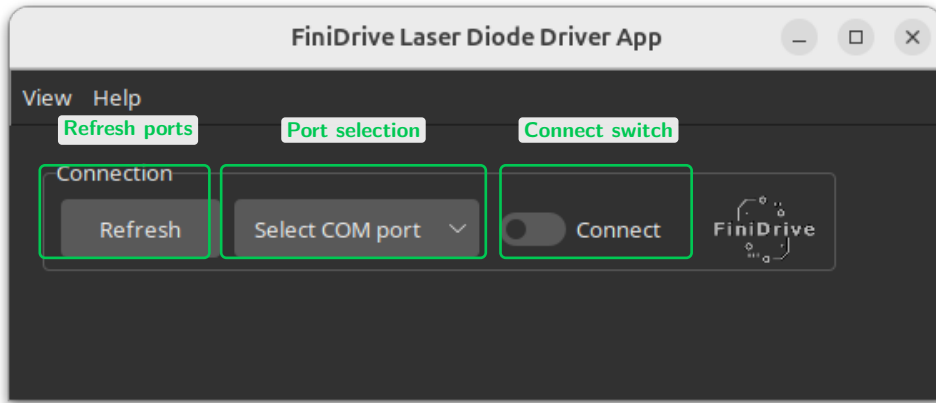


Figure A.1: Application start view before connecting to a driver.

### A.3 Connecting to a driver

1. Connect the driver to the PC using the selected communication interface.
2. Click **Refresh** to update the list of available COM ports.
3. Select the correct COM port from the drop-down list.
4. Switch **Connect** on.
5. Wait until the application finishes connection detection.

In single-device mode the application opens one device view. In RS-485 mode it scans the bus and opens one tab per detected driver. All setpoints, switches, status fields, measurements, and charts in a tab belong to that tab's physical driver.

The screenshots in this appendix were captured on Linux, where the connected USB device appears as a device path such as `/dev/ttyUSB0`. On Windows the same USB connection normally appears as a COM port, for example COM3, depending on the assigned port number.

If the USB connection does not appear as a COM port, or if the COM port disappears during connection attempts, check that the operating-system driver for the USB-UART bridge is installed correctly. Current HPLDD units use a CP2102 USB-UART bridge, which may require a CP210x driver package on some Windows installations.

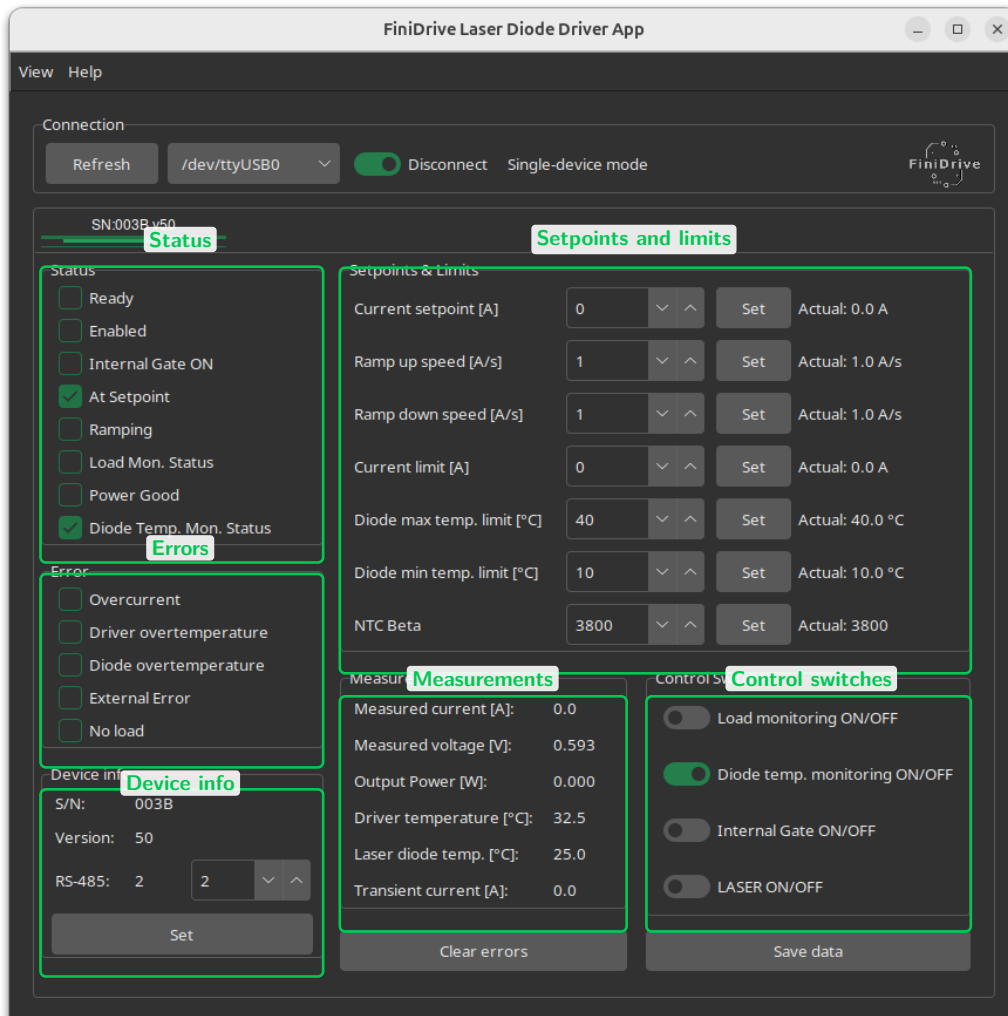


Figure A.2: Single-device view after successful connection, with no active error flags.

## A.4 Basic operating workflow

1. Confirm that the correct device tab is selected.
2. Check that no error flags are active.
3. Set a current limit suitable for the connected laser diode and selected driver model.
4. Set moderate ramp-up and ramp-down speeds for the first run.
5. Confirm diode temperature limits and monitoring state.
6. Enable the output stage with **LASER ON/OFF**.
7. Enable the internal gate with **Internal Gate ON/OFF** when output current is intended.
8. Increase the current setpoint gradually while observing measured current, output voltage, temperatures, and status flags.

## A.5 Typical first-start temperature error

A common first-start situation is a diode temperature error caused by an unconnected NTC sensor. In the example below, the driver reports the lowest readable diode temperature value,  $-10^{\circ}\text{C}$ , while the configured diode minimum temperature limit is  $10^{\circ}\text{C}$ . As a result, the Diode overtemperature error flag is active even though the physical issue is the missing temperature sensor.

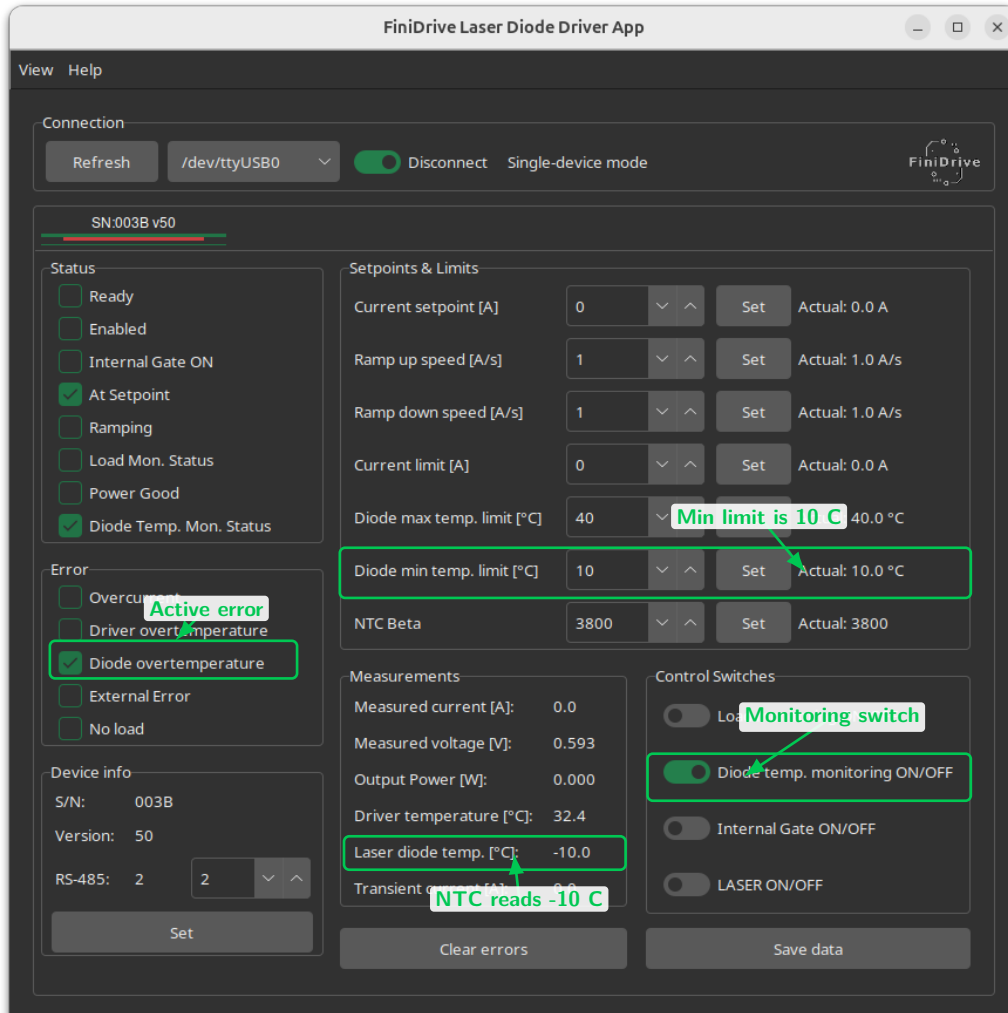


Figure A.3: Connected driver with diode temperature error caused by a missing NTC sensor.

To leave this error state, either connect the NTC sensor or disable diode temperature monitoring for setups where the external temperature input is not used. After the underlying condition has been corrected, press **Clear errors**. Clearing the error before correcting the condition is not sufficient, because the error can immediately return.

## A.6 Controls

Table A.2: Primary GUI controls

Control	Function
<b>Current setpoint</b>	Sets the requested driver output current. For first tests, increase this value from zero in small steps.
<b>Current limit</b>	Sets the maximum allowed current value. Keep this above the intended operating current but within the laser diode rating.
<b>Ramp up speed</b>	Defines how quickly the driver may increase current toward the requested setpoint.
<b>Ramp down speed</b>	Defines how quickly the driver may decrease current toward a lower setpoint.
<b>Load monitoring</b>	Enables optional load-presence supervision. Use it when the application should check that a load is connected and that measured output current follows the requested setpoint.
<b>Diode temperature monitoring</b>	Enables supervision of the external diode temperature input and configured diode temperature limits.
<b>Internal Gate</b>	Opens or closes the software-controlled gate path. Output current requires both the output stage and the relevant gate conditions to be active.
<b>LASER ON/OFF</b>	Enables or disables the output stage. Enabling the output stage alone does not force current if gate conditions or setpoint are not satisfied.
<b>Save data</b>	Stores user-modifiable persistent parameters in non-volatile memory. The active current setpoint is not restored as an active output current after a power cycle.
<b>Clear errors</b>	Clears latched error flags after the physical cause of the error has been removed.

## A.7 Status and error indicators

Table A.3: Common status indicators

Indicator	Meaning
<b>Enabled</b>	The output stage is enabled. Current can flow only if the setpoint and gate conditions also allow it.
<b>Internal Gate ON Ramping</b>	The software-controlled gate path is open. The internal current target is moving toward the requested setpoint according to the configured ramp speed. If the output stage and gate conditions are active, the output current follows this target.
<b>At Setpoint</b>	The internal current target has reached the requested value.
<b>Load Mon. Status</b>	Load monitoring is active. Its interpretation depends on the selected operating scenario and gate state.
<b>Power Good</b>	The output condition is within the expected range after the current has settled.
<b>Diode Temp. Mon. Status</b>	Diode temperature monitoring is active.

Table A.4: Common error indicators

Indicator	Typical meaning
<b>External Error</b>	The interlock loop was interrupted while the driver was enabled.
<b>Overcurrent</b>	The measured current exceeded the allowed threshold.
<b>Driver Overtemp</b>	The driver temperature exceeded the internal protection threshold.
<b>Diode Overtemp</b>	The diode temperature input exceeded the configured limits.
<b>No Load</b>	The driver expected output current, but the measured output behavior did not match the expected load condition.

## A.8 Charts

The charts can be shown or hidden from **View -> Show/Hide Charts**. They provide a live view of the main operating values:

- current chart: requested setpoint, transient current, measured current, and current limit,
- temperature chart: diode temperature, driver temperature, and configured diode temperature limits,
- power and voltage chart: calculated output power and measured output voltage.

Use the charts during first startup to confirm that the measured response follows the requested setpoint and that temperatures remain stable.

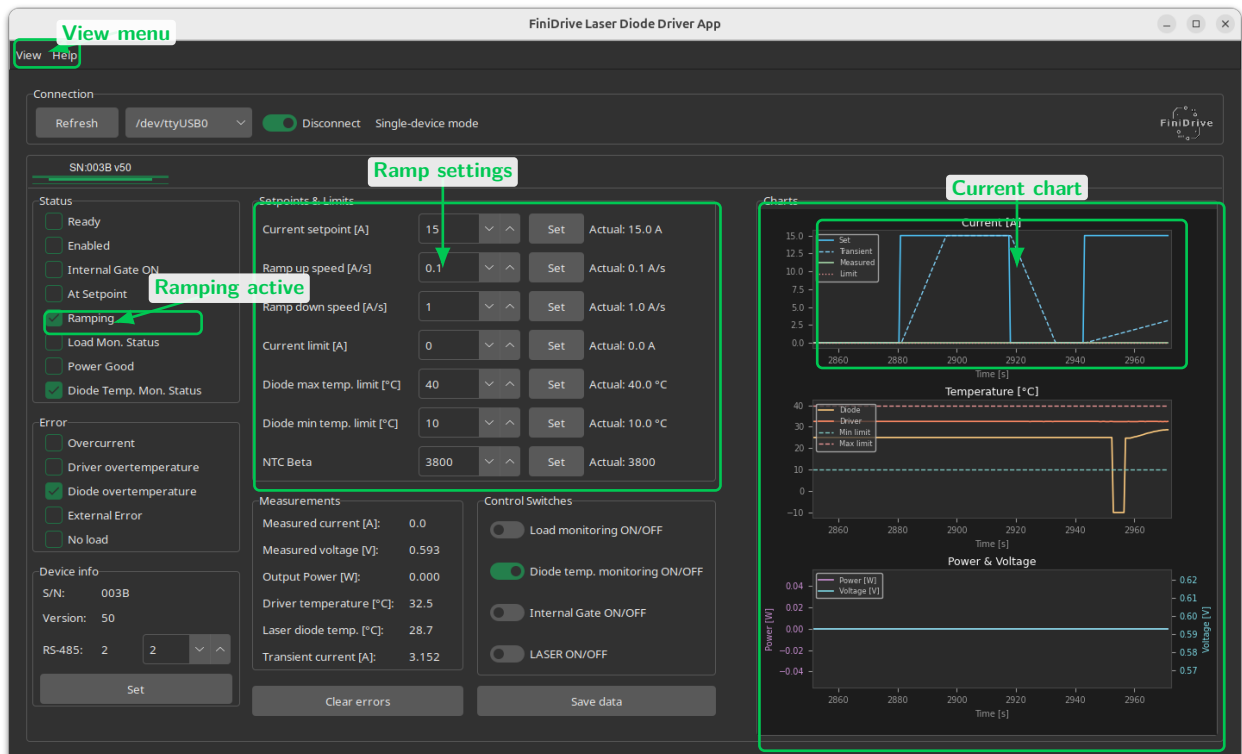


Figure A.4: GUI with charts enabled.

The current chart shows the requested setpoint as a step-like target and the transient current as the internally ramped target. Figure A.4 shows two faster 1 A/s up-down ramps followed by a slower 0.1 A/s ramp. In the slow-ramp case, the setpoint has already changed, but the transient

current has not yet reached the final requested value. The highlighted **Ramping** status indicates this intermediate state, in contrast to the **At Setpoint** state shown in Figure A.2. If the driver is enabled and the gate conditions are active, the output current follows this transient target rather than jumping instantly to the final setpoint.

## Appendix B

# Protocol and Command Reference



# HPLDD FiniDrive Protocol and Command Documentation

Native FiniDrive command set.

## Quick Contents

READ\_SET\_FINAL\_CURRENT

READ\_FINAL\_CURRENT\_MIN

READ\_FINAL\_CURRENT\_MAX

READ\_SET\_CURRENT

READ\_MEASURED\_CURRENT

READ\_SET\_RAMP\_UP

READ\_SET\_RAMP\_DOWN

READ\_SET\_MAX\_CURRENT

READ\_MEASURED\_VOLTAGE

READ\_SERIAL\_NUMBER

READ\_VERSION

READ\_SET\_CONFIGURATION\_BITS

READ\_SET\_DRIVER\_STATUS

SAVE\_DATA

READ\_RESET\_ERROR

READ\_SET\_MIN\_DIODE\_TEMP

READ\_SET\_MAX\_DIODE\_TEMP

READ\_EXTERNAL\_TEMP

READ\_INTERNAL\_TEMP

READ\_SET\_NTC\_BETA

READ\_SET\_RS485\_ADDRESS

READ\_COMM\_CHANNEL

# Protocol Overview

## Documentation Scope

### FiniDrive profile

This document covers the command set exposed through the FiniDrive command namespace. Command numbers shown below are taken from the corresponding protocol mapping.

## Communication Interfaces

The device supports the following physical communication interfaces:

- RS-232
- RS-485
- USB (COM port)

## Serial Line Parameters

Parameter	Value
Baud rate	115200
Data bits	8
Stop bits	1
Parity	None
Flow control	None

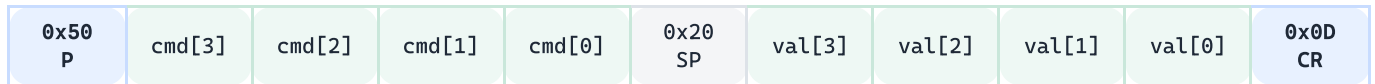
## Command Framing

### Text mode (no CRC)

#### READ



#### WRITE



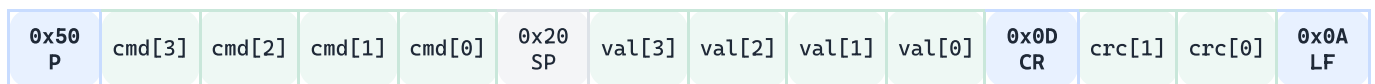
0x4A = 'J', 0x50 = 'P', 0x20 = space, 0x0D = CR. In text mode without CRC, the frame ends at CR.

### Text mode with CRC-8

#### READ



#### WRITE



0x0D = CR and 0x0A = LF are both part of the framing here. CRC-8 is calculated over all bytes from the leading J or P through CR.

### Binary mode with CRC-8

#### READ



#### WRITE

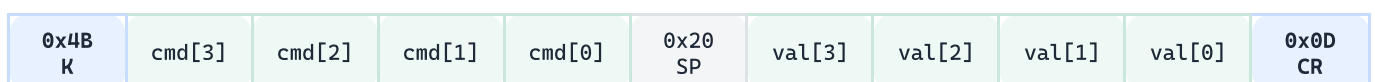


In binary mode, command and value fields are sent as raw bytes rather than ASCII hex characters. The frame is still terminated by CR, followed by CRC and LF.

## Response Framing

### Text response (no CRC)

#### SUCCESS



#### ERROR



0x4B = 'K', 0x45 = 'E'. In CRC-enabled text mode, append [crc\_hi] [crc\_lo] 0x0A after CR.

## Binary response

### SUCCESS

0x4B K	cmd_hi	cmd_lo	val_hi	val_lo	0x0D CR	crc	0x0A LF
-----------	--------	--------	--------	--------	------------	-----	------------

### ERROR

0x45 E	err_hi	err_lo	0x00	0x00	0x0D CR	crc	0x0A LF
-----------	--------	--------	------	------	------------	-----	------------

A valid implementation must treat CR and LF as framing bytes, not just visual separators in the documentation.

## RS-485 Address Extension

On RS-485 only, every command and response is wrapped with an address prefix in front of the normal inner protocol frame.

### Addressed request wrapper

#### REQUEST PREFIX

0x40 @	addr[1]	addr[0]	0x3A :	inner frame ...
-----------	---------	---------	-----------	-----------------

### Addressed response wrapper

#### RESPONSE PREFIX

0x40 @	src[1]	src[0]	0x3A :	inner response ...
-----------	--------	--------	-----------	--------------------

The address is encoded as two ASCII hex characters. Example: device address 0x02 is sent as @02: . The RS-485 wrapper itself is **not** included in CRC calculation. CRC is calculated only over the inner frame, from J / P / K / E through CR.

### Broadcast and discovery

- Broadcast address is 0x00, encoded as @00: .
- The only supported broadcast command is a read of READ\_SET\_RS485\_ADDRESS .
- Each responding device delays its discovery response by address \* 10 ms .
- Valid device addresses are from 0x01 to 0x20 (1..32 decimal).

## Commands Table

Name	FinisDrive command	Read / Write	Unit	LSB	Availability
READ_SET_FINAL_CURRENT	0x0007	Read/Write	A	1 mA	All modes
READ_FINAL_CURRENT_MIN	0x0008	Read-only	A	1 mA	All modes
READ_FINAL_CURRENT_MAX	0x0009	Read-only	A	1 mA	All modes
READ_SET_CURRENT	0x000A	Read-only	A	1 mA	All modes
READ_MEASURED_CURRENT	0x000B	Read-only	A	10 mA	All modes
READ_SET_RAMP_UP	0x000C	Read/Write	A/s	10 mA/s	All modes
READ_SET_RAMP_DOWN	0x000D	Read/Write	A/s	10 mA/s	All modes
READ_SET_MAX_CURRENT	0x000E	Read/Write	A	100 mA	All modes
READ_MEASURED_VOLTAGE	0x0016	Read-only	V	1 mV	All modes
READ_SERIAL_NUMBER	0x0018	Read-only	N/A	N/A	All modes
READ_VERSION	0x0019	Read-only	N/A	N/A	All modes
READ_SET_CONFIGURATION_BITS	0x001A	Read/Write	bitfield	N/A	All modes
READ_SET_DRIVER_STATUS	0x001B	Read/Write	bitfield	N/A	All modes
SAVE_DATA	0x001C	Read-only	N/A	N/A	All modes
READ_RESET_ERROR	0x001D	Read/Write	bitfield	N/A	All modes
READ_SET_MIN_DIODE_TEMP	0x001E	Read/Write	deg C	0.1 deg C	All modes
READ_SET_MAX_DIODE_TEMP	0x001F	Read/Write	deg C	0.1 deg C	All modes
READ_EXTERNAL_TEMP	0x0020	Read-only	deg C	0.1 deg C	All modes
READ_INTERNAL_TEMP	0x0021	Read-only	deg C	0.1 deg C	All modes
READ_SET_NTC_BETA	0x0022	Read/Write	unitless	N/A	All modes

READ_SET_RS485_ADDRESS	0x2000	Read/Write	address	1	All modes
READ_COMM_CHANNEL	0x2001	Read-only	enum	N/A	All modes

# Command Details

## READ\_SET\_FINAL\_CURRENT

Model-dependent

FiniDrive command `0x0007` | Read/Write | Unit: A | LSB: 1 mA | Availability: All modes

The allowed setpoint range depends on the connected driver model.

### Request

#### READ

`J0007`

Reads the current value or status.

#### WRITE

`P0007 VALUE`

Writes a new value or triggers the command action.

### Response

- Readback example: K0007 VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

### Range

- Unit: A
- Resolution: 1 mA
- Allowed range: reported by READ\_FINAL\_CURRENT\_MIN and READ\_FINAL\_CURRENT\_MAX.

### Side Effects

- A write starts the internal transient-current ramp toward the new setpoint.

### Persistence

- Effective immediately. Not stored by SAVE\_DATA and does not survive a power cycle.

## Detailed Description

### Function:

Sets the target output current (setpoint) of the driver. After receiving this command, the device begins adjusting the transient current toward the requested value, according to the configured `RAMP_UP` and `RAMP_DOWN` rates.

### Behaviour:

- The setpoint **always starts at 0** when the device powers up. Even if the output is enabled and all gating conditions are met, **no current will flow** until the user explicitly sets a non-zero setpoint.

### Output current becomes active only when all of the following conditions are fulfilled:

- The driver state is **Enabled**
- No error is stored in the device
- **Internal Gate In** is high
- **External Gate In** (I-PEX connector) is high or disconnected (internal pull-up)

### If any condition listed above is not met:

- The device still adjusts **transient current** internally toward the setpoint
- The actual output current remains **0**
- `READ_MEASURED_CURRENT` will report zero

### Driver status bits affected by this command:

- `AT_SETPOINT` = 1 when transient current has reached the setpoint
- `RAMPING` = 1 while transient current is changing toward the setpoint
- These bits can be read via `READ_SET_DRIVER_STATUS`

### Units and Encoding:

- Unit: amperes (A)
- Resolution: 0.001 A per LSB
- Values in commands are **sent as HEX**
- Example: to set a 1.001 A setpoint, send `0x03E9` (decimal 1001)

### Model-specific note:

- The protocol resolution is **1 mA** for both HPLDD1540 and HPLDD3040.
- Effective setpoint accuracy is model-dependent:
- **HPLDD1540:** 1 mA
- **HPLDD3040:** 2 mA

### Value Range:

As defined by `READ_FINAL_CURRENT_MIN` and `READ_FINAL_CURRENT_MAX`

### Typical Use Case:

1. Configure ramp parameters ( `READ_SET_RAMP_UP` , `READ_SET_RAMP_DOWN` )
2. Enable the driver
3. Ensure all gating conditions are fulfilled
4. Set the desired current (send HEX value) and observe how **transient** and **measured current** change over time until the setpoint is reached. Driver status changes: `AT_SETPOINT` → `RAMPING` → `AT_SETPOINT`

## READ\_FINAL\_CURRENT\_MIN

FiniDrive command `0x0008` | Read-only | Unit: A | LSB: 1 mA | Availability: All modes

### Request

#### READ

`J0008`

Reads the current value or status.

### Response

- Text mode example: K0008 VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

### Range

- Unit: A
- Resolution: 1 mA
- Reported range depends on the measured or internal device state.

### Side Effects

- Read operation only. No side effects.

### Persistence

- No persistent change.

---

## Detailed Description

### Function:

Reports the minimum configurable final current.

### Example:

In case of HPLDD1540 minimum current is 0 A -> HEX 0000.

# READ\_FINAL\_CURRENT\_MAX

Model-dependent

FiniDrive command `0x0009` | Read-only | Unit: A | LSB: 1 mA | Availability: All modes

Typical values: HPLDD1540 = 15 A, HPLDD3040 = 30 A.

## Request

**READ**

`J0009`

Reads the current value or status.

## Response

- Text mode example: K0009 VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

## Range

- Reported in A with 1 mA resolution.
- Returned value depends on the connected driver model.

## Side Effects

- Read operation only. No side effects.

## Persistence

- No persistent change.

## Detailed Description

### Function:

Reports the maximum configurable final current.

### Example:

- HPLDD1540: 15 A -> 15000 mA -> HEX `3A98`
- HPLDD3040: 30 A -> 30000 mA -> HEX `7530`

# READ\_SET\_CURRENT

FiniDrive command `0x000A` | Read-only | Unit: A | LSB: 1 mA | Availability: All modes

## Request

### READ

`J000A`

Reads the current value or status.

## Response

- Text mode example: K000A VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

## Range

- Unit: A
- Resolution: 1 mA
- Reported range depends on the measured or internal device state.

## Side Effects

- Read operation only. No side effects.

## Persistence

- No persistent change.

---

## Detailed Description

### Function:

Returns the transient current setpoint at this moment. Shows what current **would** flow if all gating conditions are met.

# READ\_MEASURED\_CURRENT

FiniDrive command `0x000B` | Read-only | Unit: A | LSB: 10 mA | Availability: All modes

## Request

### READ

`J000B`

Reads the current value or status.

## Response

- Text mode example: K000B VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

## Range

- Unit: A
- Resolution: 10 mA
- Reported range depends on the measured or internal device state.

## Side Effects

- Read operation only. No side effects.

## Persistence

- No persistent change.

---

## Detailed Description

Returns the actually measured output current in A (1 LSB = 10 mA).

# READ\_SET\_RAMP\_UP

Persistence

FiniDrive command `0x000C` | Read/Write | Unit: A/s | LSB: 10 mA/s | Availability: All modes

## Request

### READ

`J000C`

Reads the current value or status.

### WRITE

`P000C VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K000C VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: A/s
- Resolution: 10 mA/s
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write updates the ramp configuration used for subsequent current transitions.

## Persistence

- Effective immediately; persistent only after SAVE\_DATA.

## Detailed Description

### Function:

Sets the upward ramp rate for transient current changes. The device uses this value to gradually increase the output current toward a setpoint. Controllable rate of change is available from 0.01 A/s to 600 A/s.

### Behaviour:

- The ramp rate is applied to future current setpoint changes.
- If a new ramp rate is sent while a current ramp is ongoing, it **takes effect on the next setpoint change**.
- To apply an immediate ramp rate change during ramping, send the new ramp value followed by the target current setpoint.
- Setting the ramp value to zero means "instantaneous change" (effectively infinite ramp), which bypasses ramping.
- **Warning:** Instantaneous ramp can cause temporary overshoot, depending on the setpoint and load impedance.

# READ\_SET\_RAMP\_DOWN

Persistence

FiniDrive command `0x000D` | Read/Write | Unit: A/s | LSB: 10 mA/s | Availability: All modes

## Request

### READ

`J000D`

Reads the current value or status.

### WRITE

`P000D VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K000D VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: A/s
- Resolution: 10 mA/s
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write updates the ramp configuration used for subsequent current transitions.

## Persistence

- Effective immediately; persistent only after SAVE\_DATA.

## Detailed Description

### Function:

Sets the downward ramp rate for transient current changes. The device uses this value to gradually decrease the output current toward a setpoint. Controllable rate of change is available from 0.01 A/s to 600 A/s.

### Behaviour:

- The ramp rate is applied to future current setpoint changes.
- If a new ramp rate is sent while a current ramp is ongoing, it **takes effect on the next setpoint change**.
- To apply an immediate change in ramp rate during ramping, send the new ramp value followed by the target current setpoint.
- Setting the ramp value to zero means "instantaneous change" (effectively infinite ramp), which bypasses ramping.
- **Warning:** Instantaneous ramp can cause temporary overshoot, depending on the setpoint and load impedance.

# READ\_SET\_MAX\_CURRENT

Persistence

FiniDrive command `0x000E` | Read/Write | Unit: A | LSB: 100 mA | Availability: All modes

## Request

### READ

`J000E`

Reads the current value or status.

### WRITE

`P000E VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K000E VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: A
- Resolution: 100 mA
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write updates the hardware overcurrent threshold immediately.

## Persistence

- Effective immediately; persistent only after SAVE\_DATA.

## Detailed Description

### Function:

Sets or reads the internal current reference used by the fast hardware overcurrent protection comparator. The reference value is continuously compared with the measured output current. If the measured current exceeds the configured threshold, the driver is immediately disabled and the OVERCURRENT error is raised. Value `0` for this command is interpreted as disabling this feature.

### Operation

Direction	Meaning
Write	Updates the current reference for the hardware overcurrent protection comparator. The new threshold becomes active immediately after the write.
Read	Returns the currently configured overcurrent protection threshold.

### Units and Encoding

- Unit: amperes (A)
- Resolution: 0.1 A per LSB
- Values are sent as hexadecimal integers

- Example: 10 A = decimal `100` = hexadecimal `0x0064`

### **Behaviour:**

- If the measured current exceeds the threshold set by this command, the driver output is cut off immediately.
- The overcurrent reaction is fully hardware-based - the response is effectively instantaneous and bypasses firmware.
- The protection may trigger even when the setpoint is below `CURRENT_MAX` if a startup overshoot exceeds the comparator threshold.
- This hardware protection operates independently of ramping settings and firmware logic.
- After an `OVERCURRENT` event, driver errors must be cleared before enabling the output again.

### **Typical Use Case:**

- Defining the maximum allowable current according to the laser's safe operating area.
- Protecting the system from sudden current spikes.
- Threshold calibration during laboratory testing.

### **Safety Notes:**

- Setting `CURRENT_MAX` too low may cause unwanted protection trips during normal current ramp up.
- Setting `CURRENT_MAX` too high may allow damaging currents before firmware can react.
- If large setpoints are enabled without ramping, `CURRENT_MAX` should be configured high enough to tolerate the expected overshoot.

### **Driver reaction on overcurrent trigger:**

- Output current is immediately disabled (hardware cutoff).
- Driver state changes to `ERROR`.
- The `OVERCURRENT` error flag is set and must be cleared using `CLEAR_ERRORS`.
- `READ_MEASURED_CURRENT` will report 0 A after the cutoff.

## READ\_MEASURED\_VOLTAGE

FiniDrive command `0x0016` | Read-only | Unit: V | LSB: 1 mV | Availability: All modes

### Request

#### READ

`J0016`

Reads the current value or status.

### Response

- Text mode example: K0016 VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

### Range

- Unit: V
- Resolution: 1 mV
- Reported range depends on the measured or internal device state.

### Side Effects

- Read operation only. No side effects.

### Persistence

- No persistent change.

## Detailed Description

Returns the actual output voltage measured at the driver's sensing point. The value reflects the instantaneous load voltage seen by the power stage.

### Notes

- Measurement is updated continuously by the ADC subsystem.
- Useful for diagnostics such as load presence, wiring issues, or diode forward voltage monitoring.

# READ\_SERIAL\_NUMBER

FiniDrive command `0x0018` | Read-only | Unit: N/A | LSB: N/A | Availability: All modes

## Request

### READ

`J0018`

Reads the current value or status.

## Response

- Text mode example: K0018 VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

## Range

- Reported range depends on the measured or internal device state.

## Side Effects

- Read operation only. No side effects.

## Persistence

- No persistent change.

---

## Detailed Description

Returns the driver serial number.

## READ\_VERSION

FiniDrive command `0x0019` | Read-only | Unit: N/A | LSB: N/A | Availability: All modes

### Request

#### READ

`J0019`

Reads the current value or status.

### Response

- Text mode example: K0019 VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

### Range

- Reported range depends on the measured or internal device state.

### Side Effects

- Read operation only. No side effects.

### Persistence

- No persistent change.

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## Detailed Description

Returns the driver firmware version.

# READ\_SET\_CONFIGURATION\_BITS

FiniDrive command `0x001A` | Read/Write | Unit: bitfield | LSB: N/A | Availability: All modes

Interface-specific

Persistence

This command affects the communication layer itself. After changing protocol settings, the host may need to adjust how it talks to the device.

## Request

### READ

`J001A`

Reads the current value or status.

### WRITE

`P001A VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K001A VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: bitfield
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- May change checksum handling, autoreturn behavior, baudrate encoding, or text/binary mode.

## Persistence

- Effective immediately; persistent only after `SAVE_DATA`.

## Detailed Description

### Function:

Allows reading and modifying communication-related configuration parameters of the driver. This command controls checksum usage, autoreturn behaviour for write commands, baudrate settings, and the communication format (text or binary mode).

**Important implementation note:**

Even though several baudrate options exist in the protocol definition, **the current firmware supports only 115200 baud.**

Any write request attempting to set a different baudrate is accepted syntactically, but the device will still operate at 115200 baud and will report 115200 baud as the active setting when this configuration is read back.

**Write actions**

Value	Name	Effect
0x0002	CHECKSUM_ON	Enables CRC8 checksum usage.
0x0004	CHECKSUM_OFF	Disables CRC8 checksum usage.
0x0008	ENABLE_AUTORETURN_FOR_P	Enables automatic responses for write commands.
0x0010	DISABLE_AUTORETURN_FOR_P	Disables automatic responses for write commands.
0x0100	BAUDRATE_2400	Accepted syntactically, but firmware still operates at 115200 baud.
0x0120	BAUDRATE_9600	Accepted syntactically, but firmware still operates at 115200 baud.
0x0140	BAUDRATE_10417	Accepted syntactically, but firmware still operates at 115200 baud.
0x0160	BAUDRATE_19200	Accepted syntactically, but firmware still operates at 115200 baud.
0x0180	BAUDRATE_57600	Accepted syntactically, but firmware still operates at 115200 baud.
0x01A0	BAUDRATE_115200	Selects the only baudrate currently implemented by firmware.
0x0200	BINARY_ON	Switches to binary protocol mode.
0x0400	TEXT_ON	Switches to text protocol mode.

**Read bits**

Mask	Name	Meaning
0b00000010	CHECKSUM_ENABLED	1 = checksum enabled, 0 = checksum disabled.
0b00000100	AUTORETURN_FOR_P	1 = write commands return automatically, 0 = no automatic return.
0b00111000	BAUDRATE_BITS	Baudrate bitfield. Current firmware always reports 115200 baud ( 101 ).
0b01000000	BINARY_MODE	1 = binary mode, 0 = text mode.

# READ\_SET\_DRIVER\_STATUS

FiniDrive command `0x001B` | Read/Write | Unit: bitfield | LSB: N/A | Availability: All modes

## Request

### READ

`J001B`

Reads the current value or status.

### WRITE

`P001B VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K001B VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: bitfield
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write changes driver state, gating, load sensing, or temperature monitoring immediately.

## Persistence

- Effective immediately. Not stored by SAVE\_DATA and does not survive a power cycle.

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## Detailed Description

### Function:

Reads the current driver state bitfield or applies one control action.

### Read bits

Mask	Name	Meaning
0b00000001	ENABLED_STATUS	1 = driver enabled and crowbar disabled, 0 = driver disabled and crowbar enabled.
0b00000010	GATE_STATUS	1 = internal gate high, 0 = internal gate low.
0b00000100	READY_STATUS	1 = driver enabled with gate low. 0 = driver disabled or driver enabled with gate high.
0b00001000	ATSETPOINT_STATUS	1 = transient current equals target setpoint, 0 = transient current still differs from target setpoint.
0b00010000	RAMPING_STATUS	1 = transient current is actively moving toward the target setpoint, 0 = target already reached.
0b00100000	POWERGOOD_STATUS	1 = measured current is within $\pm 10\%$ of set current while the device is at setpoint, 0 = outside that band.
0b01000000	LOAD_SENS_STATUS	1 = load sensing enabled, 0 = load sensing disabled. When enabled, the driver can raise <b>NO_LOAD_ERR</b> if the expected current is not detected.
0b10000000	TEMP_MON_STATUS	1 = diode temperature monitoring enabled, 0 = temperature monitoring disabled.

### Write values

Value	Name	Effect
0b00000001	ENABLE_DRIVER	Enables the driver output stage and disables crowbar.
0b00000010	DISABLE_DRIVER	Disables the driver output stage and enables crowbar.
0b00000100	TURN_GATE_ON	Sets the internal gate high.
0b00001000	TURN_GATE_OFF	Sets the internal gate low.
0b00010000	TURN_LOAD_SENS_ON	Enables load sensing.
0b00100000	TURN_LOAD_SENS_OFF	Disables load sensing.
0b01000000	TURN_TEMP_MON_ON	Enables diode temperature monitoring.
0b10000000	TURN_TEMP_MON_OFF	Disables diode temperature monitoring.

### Notes

- The read command returns the current device state, not the last write command.
- The write command accepts one action bit at a time. Bits are not combined.

# SAVE\_DATA

Persistence

FiniDrive command `0x001C` | Read-only | Unit: N/A | LSB: N/A | Availability: All modes

This command is triggered as a read-form command and does not carry a value payload.

## Request

READ

`J001C`

Reads the current value or status.

## Response

- Uses the standard response framing for the selected communication mode.
- When autoreturn is disabled, the host should not expect an immediate confirmation payload.

## Range

- No value payload.

## Side Effects

- Commits the current writable settings to non-volatile memory.

## Persistence

- This command stores the current runtime settings so they survive a power cycle.

## Detailed Description

Saves all user-modifiable parameters to non-volatile memory. Values are applied after power cycle. Every settable parameter is remembered except the setpoint current. No current will flow until the user explicitly sets a non-zero setpoint. This command is triggered as `J001C` / `J0706` and does not carry a value payload.

# READ\_RESET\_ERROR

Runtime state

FiniDrive command `0x001D` | Read/Write | Unit: bitfield | LSB: N/A | Availability: All modes

## Request

### READ

`J001D`

Reads the current value or status.

### WRITE

`P001D VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K001D VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: bitfield
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write clears the active error flags immediately.

## Persistence

- Not persistent. This only affects the current runtime error state.

## Detailed Description

### Function:

Reads the current error bitfield or clears active error flags.

### Read bits

Mask	Name	Meaning
0b00000010	INTERLOCK_ERR	Interlock error. Triggered when the interlock loop is open while the driver is enabled. Interlock enforcement is hardware-based and immediately disables the converter path while asserting crowbar behavior on the output.
0b00001000	OVERCURRENT_ERR	Overcurrent protection error. The measured current exceeded the allowed threshold.
0b00010000	DRIVER_OVERTEMP_ERR	Driver over-temperature error. Internal thermal limit exceeded.
0b00100000	DIODE_OVERTEMP_ERR	External diode / laser module over-temperature error.
0b01000000	NO_LOAD_ERR	No-load condition detected. Indicates an open circuit or missing load.

#### Write behavior

Write frame	Effect
P001D 0000	Clears all active error flags. This is the recommended value for clarity and consistency.

#### Notes

- The read command returns the current error state.
- Some errors can reappear immediately if the fault condition is still present.
- Clearing the error flag does not override the live interlock input.

# READ\_SET\_MIN\_DIODE\_TEMP

Persistence

FiniDrive command `0x001E` | Read/Write | Unit: deg C | LSB: 0.1 deg C | Availability: All modes

## Request

### READ

`J001E`

Reads the current value or status.

### WRITE

`P001E VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K001E VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: deg C
- Resolution: 0.1 deg C
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write updates the temperature-monitoring configuration immediately.

## Persistence

- Effective immediately; persistent only after SAVE\_DATA.

## Detailed Description

Sets or reads the minimum diode temperature.

LSB -> 0.1 deg C

int16\_t

# READ\_SET\_MAX\_DIODE\_TEMP

Persistence

FiniDrive command `0x001F` | Read/Write | Unit: deg C | LSB: 0.1 deg C | Availability: All modes

## Request

### READ

`J001F`

Reads the current value or status.

### WRITE

`P001F VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K001F VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: deg C
- Resolution: 0.1 deg C
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write updates the temperature-monitoring configuration immediately.

## Persistence

- Effective immediately; persistent only after SAVE\_DATA.

## Detailed Description

Sets or reads the maximum diode temperature.

LSB -> 0.1 deg C

int16\_t

## READ\_EXTERNAL\_TEMP

FiniDrive command `0x0020` | Read-only | Unit: deg C | LSB: 0.1 deg C | Availability: All modes

### Request

#### READ

`J0020`

Reads the current value or status.

### Response

- Text mode example: K0020 VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

### Range

- Unit: deg C
- Resolution: 0.1 deg C
- Reported range depends on the measured or internal device state.

### Side Effects

- Read operation only. No side effects.

### Persistence

- No persistent change.

---

### Detailed Description

Reads temperature of the externally connected NTC.

LSB -> 0.1 deg C

int16\_t

## READ\_INTERNAL\_TEMP

FiniDrive command `0x0021` | Read-only | Unit: deg C | LSB: 0.1 deg C | Availability: All modes

### Request

#### READ

`J0021`

Reads the current value or status.

### Response

- Text mode example: K0021 VALUE.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

### Range

- Unit: deg C
- Resolution: 0.1 deg C
- Reported range depends on the measured or internal device state.

### Side Effects

- Read operation only. No side effects.

### Persistence

- No persistent change.

---

## Detailed Description

Reads temperature of the driver. If this temperature exceeds 80 degrees the driver will disable the output current, enable crowbar and raise DRIVER\_OVERTEMP\_ERR.

LSB -> 0.1 deg C

int16\_t

# READ\_SET\_NTC\_BETA

Persistence

FiniDrive command `0x0022` | Read/Write | Unit: unitless | LSB: N/A | Availability: All modes

## Request

### READ

`J0022`

Reads the current value or status.

### WRITE

`P0022 VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K0022 VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Unit: unitless
- Refer to the detailed description below for command-specific limits and constraints.

## Side Effects

- A write updates the temperature-monitoring configuration immediately.

## Persistence

- Effective immediately; persistent only after SAVE\_DATA.

## Detailed Description

Sets or reads the NTC Beta value for calculation of the temperature of externally connected NTC.

# READ\_SET\_RS485\_ADDRESS

FiniDrive command `0x2000` | Read/Write | Unit: address | LSB: 1 | Availability: All modes

Interface-specific

Persistence

This command is also used as the only supported RS-485 broadcast discovery command.

## Request

### READ

`J2000`

Reads the current value or status.

### WRITE

`P2000 VALUE`

Writes a new value or triggers the command action.

## Response

- Readback example: K2000 VALUE.
- For write operations, an immediate response depends on the active autoreturn / protocol configuration.

## Range

- Valid device addresses: 1..32 decimal (0x0001..0x0020).
- Address 0x0000 is reserved for broadcast and cannot be assigned to a device.

## Side Effects

- A valid write changes the active RS-485 node address immediately.
- A broadcast read triggers RS-485 device discovery responses.

## Persistence

- Effective immediately; persistent only after SAVE\_DATA.

## Detailed Description

### Function:

Reads or sets the stored RS-485 node address of the device.

### Behaviour:

- Valid unicast node addresses are from 1 to 32 decimal ( `0x0001` to `0x0020` ).
- Address `0x0000` is reserved for RS-485 broadcast and cannot be assigned to a device.
- The default device address is `0x0001` .
- This command can be used over USB or RS-232 as a preparation step before connecting the device to an RS-485 multi-drop network.

### Broadcast discovery:

- On RS-485, a broadcast read of this command is the only supported broadcast operation.
- A broadcast discovery frame is sent to address `00` using the RS-485 wrapper: `@00:J2000 ...`
- Each device that receives this command responds with its own address in the wrapper and returns its configured address as the value.
- To reduce response collisions, each responding device delays its response by `address * 10 ms`.
- Any other broadcast command is ignored by the firmware.

**Error handling:**

- Writing an address outside the valid range returns `K0000 0001`.

**Persistence:**

- The new address becomes active immediately at runtime.
- It survives a power cycle only after `SAVE_DATA` is executed.

# READ\_COMM\_CHANNEL

Interface-specific

FiniDrive command `0x2001` | Read-only | Unit: enum | LSB: N/A | Availability: All modes

Useful for host software that needs to allow or block features depending on the active transport.

## Request

### READ

`J2001`

Reads the current value or status.

## Response

- Text mode example: `K2001 VALUE`.
- In CRC-enabled or binary modes, the same command/value pair is wrapped in the corresponding protocol framing.

## Range

- `0x0001` = USB
- `0x0002` = RS-232
- `0x0003` = RS-485

## Side Effects

- Read operation only. No side effects.

## Persistence

- No persistent change.

## Detailed Description

### Function:

Reports which physical communication channel is currently being used for the active request.

### Returned values:

- `0x0001` - USB
- `0x0002` - RS-232
- `0x0003` - RS-485

### Behaviour:

- The reported value depends on the UART or USB interface on which the command was received.
- This command is read-only. A write attempt returns `K0000 0001`.
- Older firmware revisions may not implement this command.