LK500
Rack-Mounted Chiller

User Guide



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Chapter 1 Introduction

1.1 Intended Use

The Rack-Mounted Chiller is an "off-the-shelf" liquid cooling system that offers precise temperature control and/or cooling below ambient temperatures. The chiller has a heating function that offers coolant temperature well above ambient temperature and brings coolant temperature up to an application's requirement faster than the refrigeration cycle.

The chiller features a 5U rack mount design and is perfect for laser and laboratory instrument cooling applications. Mountable in a rack, this industrial water-cooling system allows the stacking of related devices, providing a high level of flexibility.

The product may only be used in accordance with the instructions described in this manual. Any other use will invalidate the warranty.

1.2 Explanation of Safety Warnings

⚠ DANGER Danger indicates a hazard with a high level of risk that, if not avoided, will result in death or serious injury.

⚠WARNING Warning indicates a hazard with a medium level of risk that, if not avoided, could result in death or serious injury.

⚠CAUTION Caution indicates a hazard with a low level of risk that, if not avoided, could result in minor or moderate injury.

NOTICE Indicates information considered important, but not hazard-related, such as possible damage to the product.



ESD Component Caution



The CE markings on the product are the manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety, and environmental protection legislation.



The wheelie bin symbol on the product, the accessories or packaging indicates that this device must not be treated as unsorted municipal waste but must be collected separately.

1.3 Description

Thorlabs Rack-Mounted Chiller is based on a compressor that offers outstanding performance and high reliability as well as quiet operation and ease-of-use. Components inside the chiller have been performance-matched for quiet operation.

The chiller consists of a refrigeration system, a coolant loop, associated controls, and plumbing. The pump draws coolant from the internal reservoir and pumps it out to cool the process equipment, and then the coolant flows back to the chiller. The fluid then flows through the evaporator, where the heat is removed, and then back to the reservoir tank.

The chiller uses a standard refrigeration system to keep the coolant at the temperature set point. The compressor compresses the refrigerant vapor. The vapor then passes through the condenser where it is cooled and turns into a liquid. The refrigerant then passes through the evaporator. The coolant also flows into the evaporator, through passages separated by thin layers of metal from the refrigerant. The refrigerant evaporates, drawing heat from the coolant. The refrigerant vapor returns to the compressor and continues the cycle.

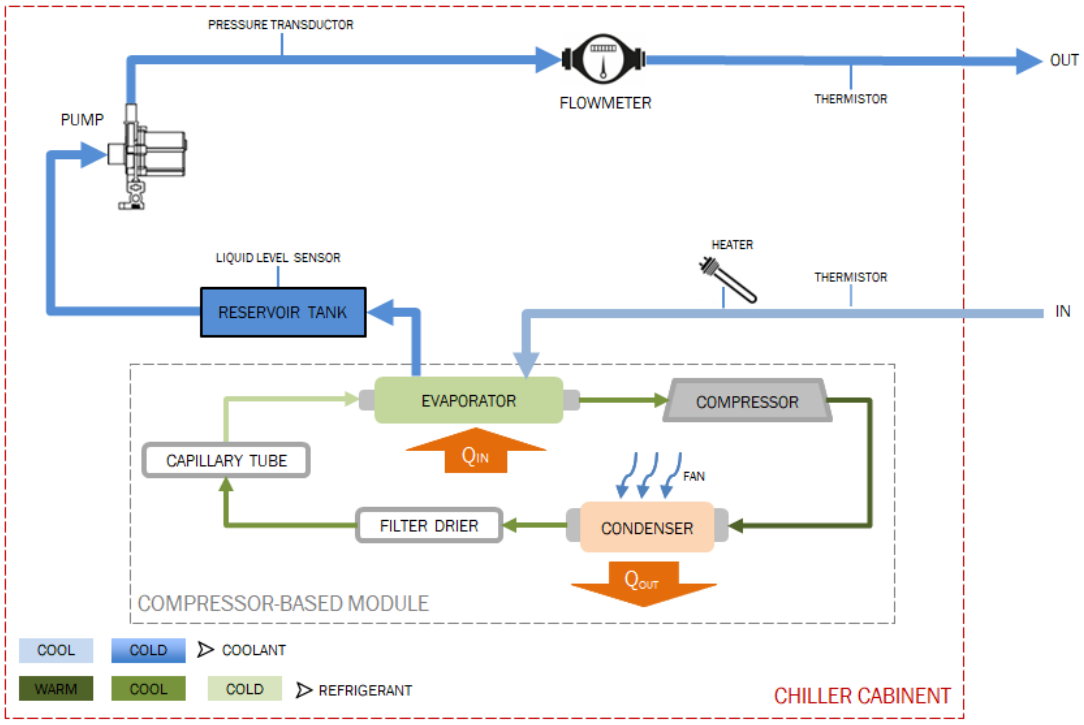


Figure 1 Plumbing & Refrigeration Diagram

The chiller uses R290 as a natural refrigerant, offering low global warming potential and zero ozone depletion potential. R290 is a refrigerant-grade propane used on a wide range of commercial refrigeration and air conditioning units. A highly pure propane, it has a low environmental impact and nominal global warming potential (GWP), meaning it possesses no qualities that can destroy the ozone layer. R290 also is the preferred hydrocarbon alternative of the Environmental Protection Agency (EPA), substituting for more harmful fluorocarbon refrigerants like R22, R134a, R404a, and R502.

Custom Proportional-Integral-Derivative (PID) controllers and advanced refrigeration control circuits ensure that the chiller maintains ±0.1°C stability. Our high-performance components enable chillers to meet high reliability standards in even the most demanding applications.

A new design feature contributes to the high operational reliability of the chiller: most components can be accessed from the front, which means that the unit no longer needs to be taken out of the mounting rack for maintenance work.

1.4 Technical Data

1.4.1 Specifications

Specifications[a]	
Temperature Control Specifications	
Maximum Cooling Power	500 W @ 25 °C Liquid & Ambient (0 °C Difference in Temperature)
Maximum Heating Power	500 W @ 25 °C Liquid & 220 VAC Power Supply
Temperature Setting Range[b]	-5 °C to 45 °C (23 °F to 122 °F)
Temperature Readout Resolution	0.01 °C
Temperature Stability	±0.1 °C @ ≥ 0.5 Lpm Flow with Constant Load at Constant Ambient Temperature
Pump Specifications	
Pump Type	Brushless DC Magnetic Drive
Static Pressure	0.8 bar (11.6 psi) (Typical)
General Specifications	
Noise (at 1 m)	56 dBA Max
Refrigerant Type	R290
Reservoir Capacity	0.6 L
Pumping Capacity	1.8 Lpm @ 25 °C Liquid & Short Inlet and Outlet
Power Supply	100 - 240 VAC, 50 - 60 Hz
Power Consumption[c]	450 - 750 VA @ 100 - 240 VAC
Operating Temperature	0 °C to 40 °C (32 °F to 104 °F)
Operating Humidity	30% RH to 80% RH (Non-Condensing)
Storage Temperature	-15 °C to 60 °C
IN/OUT Connection	CPC®* 1/4" Hose Barb Valved Panel Mount Coupling Insert
DRAIN Connection	CPC® 1/4" Hose Barb Valved Panel Mount Coupling Body
Dimensions (W x D x H)[d]	482.6 mm x 377.2 mm x 222.3 mm (19.00" x 14.85"x 8.75")
Dry Weight	15.7 kg

a. Specifications obtained at sea level using CDTX Coolflow DTX refrigerant antifreeze as the recirculating fluid, at a 25 °C target setpoint, 25 °C ambient condition, and at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude, or operating voltages will affect performance. See **Chapter 3**.
b. The actual achievable temperature range is related to the thermal load, ambient temperature, and the freezing point of the coolant.
c. This is the steady-state power after thermal equilibrium. Inrush Power (cold start): ≤1500 W (Peak).
d. Not Including Filters, External Valves, Connectors, Reservoir Filler, and Feet

** CPC® is a registered trademark of Colder Products Company.*

1.4.2 Performance Graphs

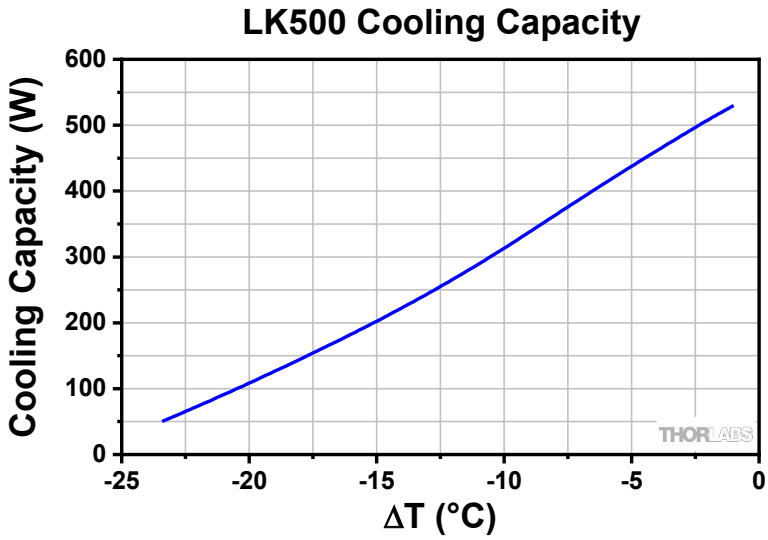


Figure 2 Nominal Cooling Capacity

NOTE:

- Pump performance results were obtained with no restrictions on the return to the system or with any options installed.
- Specifications obtained at sea level using CDTX Coolflow DTX refrigerant antifreeze as the recirculating fluid, 25 °C ambient condition, at nominal operating voltage. Other fluids, fluid temperatures, ambient temperatures, altitude or operating voltages will affect performance. See Chapter 3.

1.4.3 Mechanical Drawings

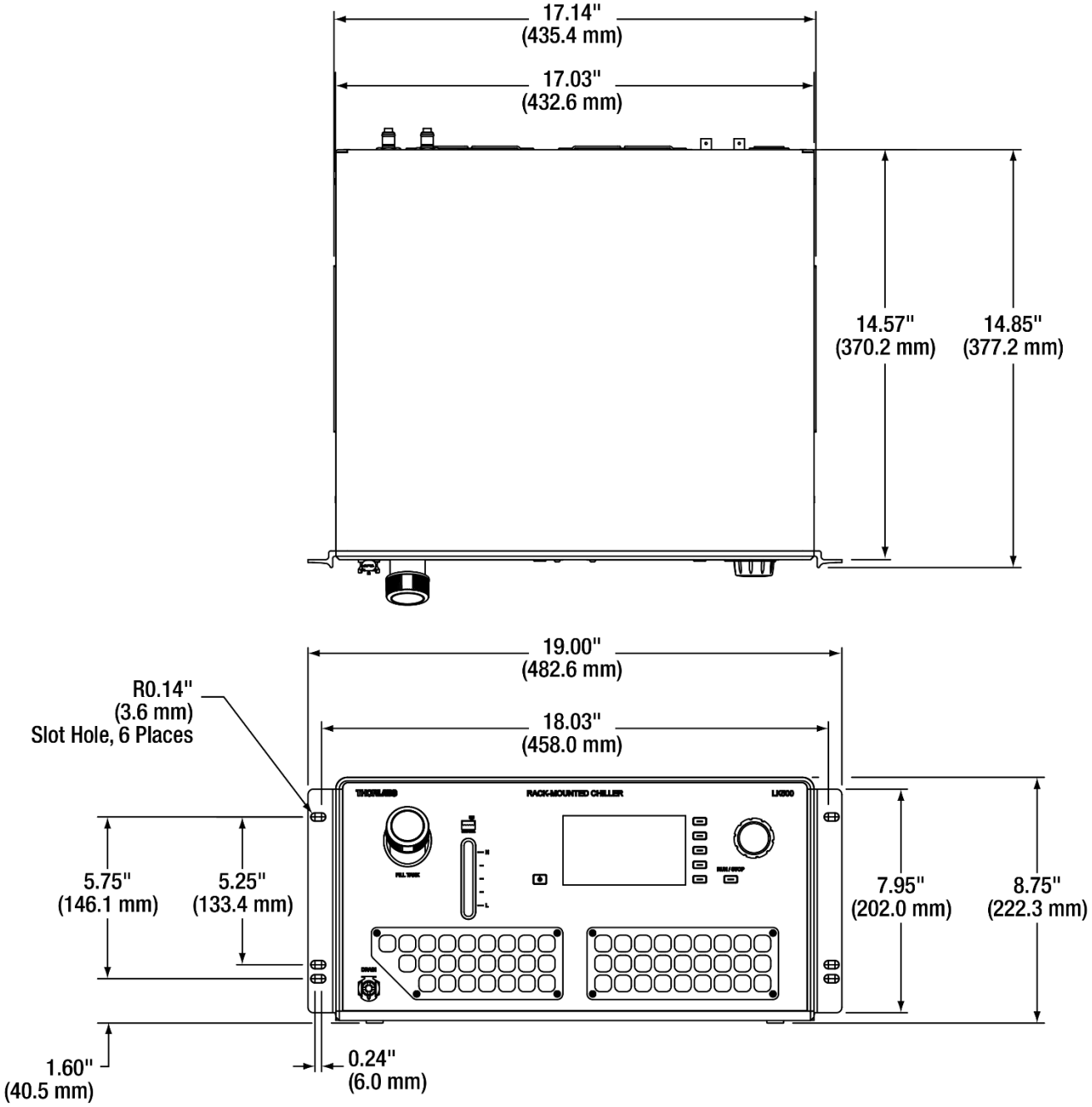


Figure 3 Mechanical Drawing

1.5 Front & Back Panels

1.5.1 Front Panel



Figure 4 Front Panel

LK500 Rack-Mounted Chiller Front Panel	
Callout	**Description**
1	Coolant Filler Cap
2	Liquid Level Indicator
3	Ambient-Temperature Air Intake
4	1/4" Hose Barb Valved Panel Mount Coupling Body for Coolant Drain
5	Standby Power Button
6	Five Dynamic Side Menu Buttons
7	Rotary Knob
8	RUN / STOP Button
9	5" Touchscreen Display

1.5.2 Back Panel

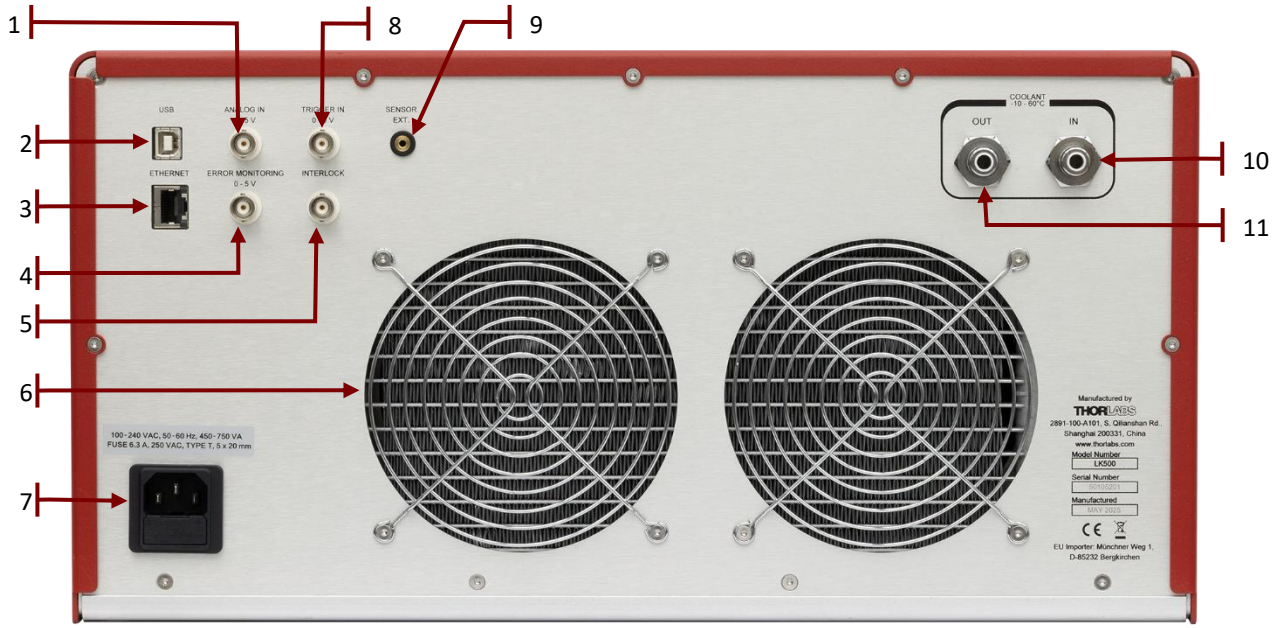


Figure 5 Back Panel

LK500 Rack-Mounted Chiller Back Panel	
Callout	**Description**
1	BNC Female for Analog In
2	USB Connector: Type B
3	Ethernet Connector: RJ45
4	BNC Female for Interlock
5	BNC Female for Error Monitoring
6	Fan
7	Power Inlet: IEC-60320 C14
8	BNC Female for Trigger In
9	Sensor EXT.: 2.5 mm RCA/Phono Socket
10	1/4" Hose Barb Valved Panel Mount Coupling Insert for Coolant In
11	1/4" Hose Barb Valved Panel Mount Coupling Insert for Coolant Out

1.6 Simplified Declaration of Conformity

The full text of the EU declaration of conformity is available at the following internet address:
https://www.thorlabs.com/f325845

1.7 FCC Designation

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Chapter 2 Safety

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly in accordance with this user manual.

DANGER

Risk of Electrical Shock
High voltage inside. Never operate the unit without the cover installed. Failure to do so could result in damage to the equipment, personal injury, and/or death.

WARNING

Always turn the chiller off and disconnect it from its supply voltage before moving.

NOTICE

Drain the chiller of all water when transporting, shipping, or leaving unused for long periods of time. This will prevent freezing, and algae build up while idle.

NOTICE

Always keep the chiller upright during operation. Additionally, THE UNIT MUST BE KEPT UPRIGHT FOR AT LEAST 24 HOURS BEFORE POWERING ON. This is to allow enough oil to reach the compressor. Powering-on the unit too early can permanently damage the compressor and is not covered by the product warranty.



ESD Component Caution
The components inside this instrument are ESD sensitive. Take all appropriate precautions to discharge personnel and equipment before making any electrical connections to the unit.

Chapter 3 Installation

3.1 Warranty Information

NOTICE

Performance of installation, operation, or maintenance procedures other than those described in this manual may result in a hazardous situation and may void the Thorlabs warranty.

Units should be drained of all fluids before being packaged in their original packaging.

This precision device is only serviceable if returned and properly packed into the complete original packaging including the complete shipment plus the cardboard insert that holds the enclosed devices. If necessary, ask for replacement packaging. Refer servicing to qualified personnel.

3.2 Transporting, Handling, Moving

⚠CAUTION

Bend Knees When Lifting
Bend your knees and not your waist when lifting. Avoid twisting. Get help with heavy lifts.

⚠CAUTION

Drop on Foot
Keep feet clear of the chiller while lowering it.

NOTICE

Upon arrival of this product via transport or courier shipping, it must be kept upright FOR AT LEAST 24 HOURS BEFORE BEING POWERED ON to allow enough oil to reach the compressor. Powering-on the unit too early can permanently damage the compressor and is not covered by the product warranty.

The chiller tilt angle should not be more than 30° during transport and handling. This will prevent oil from exiting through the suction stub. A maximum tilt angle of 40° is allowed for a very short time. Tilting the compressor more than 40° might affect its lubrication at start-up.

3.3 Packing List

The LK500 Rack-Mounted Chiller contains the following components:

- Rack-Mounted Chiller
- 0.17" ID, 1/4" OD Hose, 5 m Length
- Region-Specific Power Cord, 1x
- Siphon Pump, 1x
- Funnel, 1x
- Item # QVM6B: CPC® 1/4" PTF Valved In-Line Coupling Body, 2x
- Item # QVF6B: CPC® 1/4" PTF Valved In-Line Coupling Insert, 1x

3.4 Unpacking Instructions

Inspect the new chiller immediately upon receiving it. Please retain all cartons and packing material until the unit is operated and found to be in good condition as the box might be needed for storage or returns.

If the unit shows shipping damage, contact the transportation company, and file a freight damage claim. The chiller has been fully tested at the Thorlabs factory with new coolant. Although the system has been drained, some residual fluid may remain. This will not hinder the performance of the chiller.

Follow these steps below to unpack:

1. Lay the packing box on a flat surface and tear off the adhesive tape on the outside of the packing carton.
2. Open the carton and take out the accessory box.
3. Take out the upper insert and the chiller. Remove with care to protect the surface and prevent scratches.

4. Please check the package to make sure you have all the components as shown in Section 3.3.

3.5 Installation Instructions

3.5.1 Selecting Chiller Location

NOTICE Do not operate or store the chiller outside. These systems are not intended for outdoor use.

NOTICE Never place the chiller in a location where excessive heat, moisture, inadequate ventilation, or corrosive materials are present.

NOTICE Always keep the chiller upright during operation. Additionally, THE UNIT MUST BE KEPT UPRIGHT FOR AT LEAST 24 HOURS BEFORE POWERING ON.

Site Requirements	
Ambient Temperature Range[a]	0 °C to 40 °C (32 °F to 104 °F)
Relative Humidity Range[b]	30% RH to 80% RH (Non-Condensing)
Operating Altitude	Sea Level to 6560 ft (2000 m)
Overvoltage Category	II
Pollution Degree	2
Degree of Protection	IP 20

a. Because of the decrease in air density, the temperature for the air entering the chiller is reduced by 2 °C per 1,000 feet of altitude above sea level. In addition, a good "Rule of Thumb" is to reduce the cooling capacity rating by approximately 3% per 1,000 feet of elevation.
b. Maximum relative humidity 80% for temperatures up to 30 °C decreasing linearly to 60% relative humidity at 35 °C.

This product must be operated in an upright orientation (shown below). Alternative orientations can prevent the coolant pump from operating properly and damage the compressor.



Figure 6 Operating Orientation

To minimize the heat gain and pressure drop through the connecting hoses, the chiller unit should be located as close as possible to the heat load (user equipment). This is more important for units with centrifugal pumps as they are not capable of high head pressures. Coolant lines are best run at or near the same level as the cooling system.

Airflow is critical to optimize performance of the chiller. The front and back of the unit must be kept clear and unobstructed. The front of the unit must have a free supply of ambient-temperature air. Ensure that the hot air exits the chiller and does not recirculate into the inlet openings.

The chiller has additional ventilation holes in its side panels. Therefore, it is not recommended to be installed against the wall. The left and right sides must have a minimum clearance of 5" (127 mm).

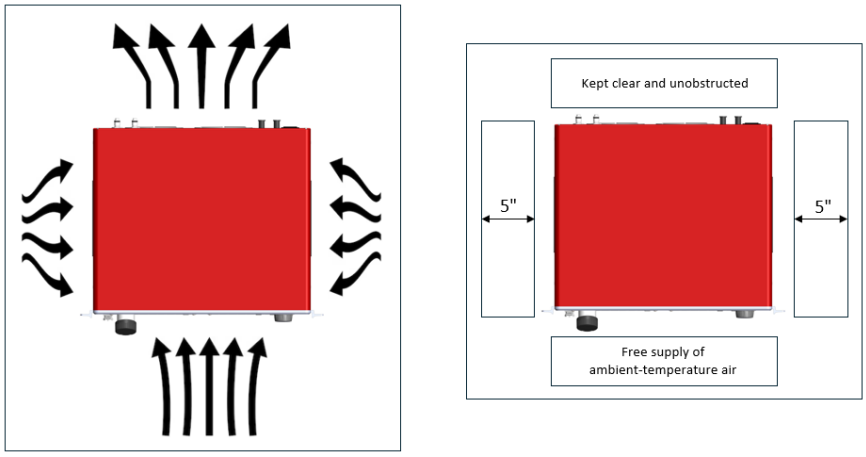


Figure 7 Airflow (Left) and Distances Should be Complied (Right)

Before moving the chiller, cap all ports to prevent any coolant leakage. To prevent freezing during storage, drain water if the chiller is located in an area below 10 °C (50 °F).

NOTE: *Depending on the setpoint and ambient temperatures, there may be a heat gain or loss through the plumbing resulting in a variation from setpoint temperature at the application. Applications with large temperature variations between ambient and setpoint temperatures, and/or long plumbing lengths, require additional insulation.*

3.5.2 Electrical Requirements

⚠ DANGER In order to avoid an electrical potential at the chiller frame due to insulation failure, a proper ground connection to the system must be provided. Failure to do so could result in damage to the equipment, personal injury, and/or death.

Refer to **Section 1.4.1** and to the product markings on the rear panel of the chiller for the specific electrical requirements of your unit. The power module is equipped with a standard IEC-320/C-14 power inlet. For safe operation, use an SJT power cord with an IEC-320/C-13 connector and a regional plug that is compatible with both your local power grid and the unit's electrical specifications. The Thorlabs LK500 rack-mounted chiller should use an SJT 3-conductor power cord with a minimum rating of 12 AWG.

3.5.3 Coolant Requirements

⚠WARNING Laboratory Grade Ethylene glycol (EG) is poisonous and flammable. Before performing any preventive maintenance refer to the manufacturer's most current SDS for handling precautions.

NOTICE

Never use flammable or corrosive fluids with this chiller. Do not use automotive antifreeze. Commercial antifreeze contains silicates that can damage the pump seals. Use of any fluid not listed below voids the manufacturer's warranty.

Strongly recommended fluid:

Non-toxic Coolflow DTX Refrigerant Antifreeze

Approved fluids are:

Filtered/Single Distilled Water

0 - 75% Laboratory Grade Ethylene Glycol/Water

NOTICE

Laboratory Grade Ethylene glycol (EG) is hygroscopic, it absorbs water from its environment. This can affect the freezing point and boiling point of the fluid over time and may result in system failure.

NOTICE

Do not use untreated tap water as the total ionized solids level may be too high.

NOTICE

Do not use aluminum with bare (unplated) copper or bare (unplated) brass in the same system. Do not use silver with nickel in the same system.

Recommended Coolant

Thorlabs recommends non-toxic Coolflow DTX Refrigerant Antifreeze with Corrosion, Scale, and Biological Inhibitors for use with chillers including the LK500 chiller.

Made with ethylene glycol, this pre-diluted coolant features more efficient heat transfer characteristics than alternatives based on propylene glycol, such as lower dynamic viscosity and higher thermal conductivity; see its Specifications table for more details.

The coolant is a colored solution for easy leak detection. And it adds an algaecide to protects against corrosion and biological growth.

Though ethylene glycol is usually toxic, Coolflow DTX contains the additive DeTox®†, which makes the solution non-harmful to humans and animals if accidentally ingested. More information regarding material safety can be found on its MSDS sheet.

Compatibility with Other Approved Fluids

- **Filtered/Single Distilled Water**

  This fluid is acceptable primarily because it has all microorganisms that cause biological fouling to be removed through vaporizing and condensing the water.

  However, distilled water does not remain pure for very long when exposed to the atmosphere. Air-born spores can contaminate the water and activate algae growth. An effective maintenance plan would include switching out the fluid with newly distilled water every three to six months.

† DeTox® is a registered trademark of Evans Cooling Systems, Inc.

- **Inhibited Ethylene Glycol/Water**

  Inhibited glycol can be used to increase the operating temperature range of the fluid but not as a “pre-mixed anticorrosive” solution. Industry standards use a pH standard of 8 to determine when the fluid has become corrosive.

- **Uninhibited Ethylene Glycol/Water**

  Ethylene glycol is used to depress the freezing point of water as a coolant. We do not recommend using uninhibited (no corrosion additives) ethylene glycol. It is more corrosive to copper than plain water, so it is not recommended unless required for the application. (If used monitor the pH as the fluid rapidly becomes acidic, especially at temperatures above 40 °C.)

Process Fluid Quality

Initially fill the reservoir with Coolflow DTX or distilled. It is acceptable to have the fluid drop to the other levels overtime. But unfavorably high total ionized solids (TIS) can accelerate the rate of galvanic corrosion. These contaminants can function as electrolytes which increase the potential for galvanic cell corrosion and lead to localized corrosion such as pitting. Eventually, the pitting becomes so extensive that refrigerant leaks into the water reservoir.

3.5.4 Selecting and Locating Hoses

- The coolant ports are located on the back of the chiller and are marked as shown.



Figure 8 LK500 Chiller Back View

- To minimize the pressure loss in the coolant lines, use the largest practical diameter tubing. If substantial lengths of cooling lines are required, they should be re-filled with coolant after connecting them to the chiller.
- To minimize heat gain, all lines should be as short as possible. Keep them away from heat sources such as radiators and hot water pipes. Lines that cannot be routed away from heat sources should be protected with thermal insulation, preferably at least 1/2" (12.7 mm) thick.
- Flexible tubing should be of heavy wall or reinforced construction. All tubing should be rated to withstand 120 psi (8.27 bar) at 23 °C (73.4 °F). Make sure all tubing connections are secured and leak tight. Also, whenever possible use opaque lines to prevent algae growth during prolonged non-operating periods.

3.5.5 Connecting Plumbing and Filling Coolant

NOTICE Fittings should either be brass, stainless steel, or nylon. Never use steel or cast-iron fittings, as the corrosion will damage the chiller.

NOTICE Only CPC® Valved Thumb Latch Quick-Disconnect fittings can be used to connect to the chiller “IN” and “OUT” port. Failure to do so could result in leakage to the equipment.

To Connect the Fluid Lines to the Chiller and User Equipment Follow These Steps:

1. Attach coolant lines to the CPC® Valved Thumb Latch Quick-Disconnect body fitting.

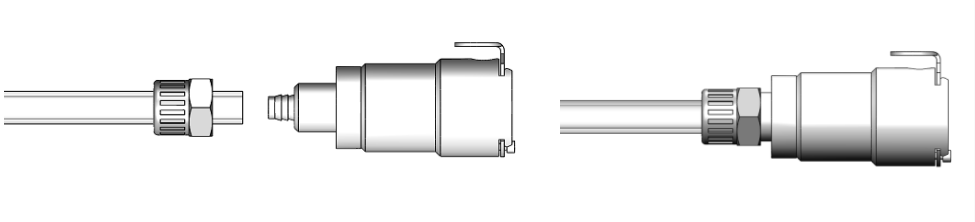


Figure 9 Ferruleless Compression Fitting for Easy Connection with Hoses

2. Connect the CPC® Valved Thumb Latch Quick-Disconnect body fitting to the "IN" and "OUT" fitting located at the back of the chiller. The "OUT" port provides chilled coolant to the user’s equipment. The "IN" port connects to the user’s device. We recommend using the LKF40 in-line filter between the "IN" port and the user’s device.



Figure 10 Connecting Hoses to the "IN" and "OUT" Ports (Left) and the In-Line Filter (Right)

NOTE: *Once there is a foreign substance in the circulating pipeline, it will cause problems such as stuck flow meters and stuck pumps, so it is highly recommended to install an impurity filter at the return piping of the chiller.*

3. Check that fittings are tight to prevent leaks.

Once All Devices (Cold Plates, Fittings, Etc.) Have Been Connected with Tubing, the System Can be Filled with Coolant.

1. The fill port is in front of the chiller. Remove the reservoir cap.



Figure 11 LK500 Chiller Front View

2. Use a bottle to fill the reservoir, using the included funnel for help if necessary. If moving coolant from a large container, we strongly recommend using the included siphon pump. Please note that this device is safe to operate even if small spills occur or the reservoir overflows. Use the liquid level indicator on the front of the unit to see the coolant level in the tank during filling. Be sure to allow for the volume of coolant needed to fill the cooling lines between the chiller and the equipment, if they were not filled with coolant before installation.

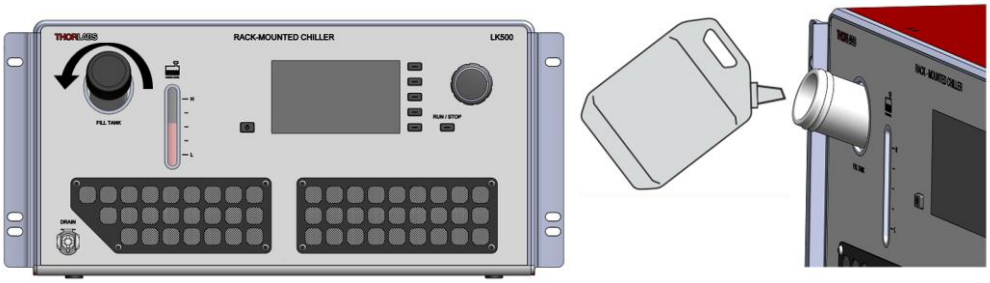


Figure 12 Removing the Plastic Cap (Left) and Filling the Reservoir (Right)

After coolant lines are purged of air, fill the reservoir approaching the “H” indicator line as indicated by the liquid level indicator. The low coolant level alarm will be active when the coolant level drops below the “L” indicator line.

Notes:

1. *If necessary, leave the reservoir open and start running the chiller. The pump will start, filling the tubes and heat load with coolant, and the air remaining inside will be released into the atmosphere at the open reservoir. If the coolant level is low, fill the reservoir with more coolant to keep the system topped off when external circulation is started.*
2. *Never completely fill or “top-off” the reservoir. An air gap must always remain to accommodate thermal expansion of the liquid. Maximum and minimum fill markings are provided on the front side of the unit to help maintain the coolant level.*

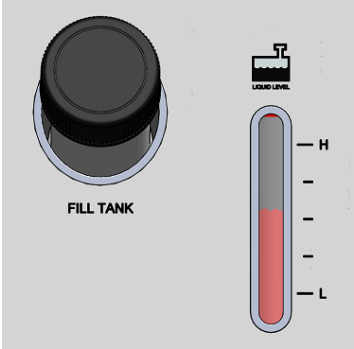


Figure 13 Recommended Liquid Level

3.5.6 Priming Centrifugal Pump

NOTICE

The cooling system's pump can not be run dry for any period of time. Do not power-on the unit without sufficient liquid in the reservoir. Dry-running (and thereby damaging the pump) is not covered under the Thorlabs warranty.

Pump Priming Must Be Performed Under the Following Conditions:

- At Initial Start-Up
- The System is Drained of its Fluid.
- A New Pump is Installed

Centrifugal pumps are classified as non-self-priming pumps. This means that the pump will not displace the air inside the pump housing, which prevents fluid from being drawn in. Each must be "primed" prior to operation. "Priming" simply means to manually introduce fluid into the pump housing prior to operation.

In a typical chiller installation, the flow of fluid through the pump suction hose into the pump is prevented by the presence of trapped air. Without a way for the air to escape, the fluid has no way of entering the pump housing. The following are recommended procedures to prime a centrifugal pump.

Method - Pump Priming

1. Attach two short hoses to the CPC® Valved Thumb Latch Quick-Disconnect body fitting.
2. Connect the CPC® Valved Thumb Latch Quick-Disconnect body fitting to the "IN" and "OUT" fitting located at the rear of the chiller.
3. Fill the reservoir. Use the liquid level indicator on the front of the unit to see the coolant level in the tank during filling. Be sure the coolant level remains below the "H" line of the indicator.
4. Allow time for the fluid to feed into the pump housing.
5. If there is difficulty priming the pump using this method, use a wet vac to assist in drawing the fluid from the tank into the pump housing. If the pump has failed to prime, turn the chiller off and contact your local Thorlabs Technical Support office.

Chapter 4 Operation

⚠WARNING In order to avoid electric shock, be sure to wipe up all fluid spills in the unit before applying electrical power. Failure to do so could result in damage to the equipment, personal injury and/or death.

NOTICE Do not start and stop the chiller too frequently, as it can cause compressor failure. The recommended start-up interval is three minutes.

NOTICE Do not use a Deionization (DI) filter cartridge with Inhibited EG or Inhibited PG. A DI filter removes inhibitors from the solution rendering the fluid ineffective against corrosion protection. Also, inhibitors increase fluid conductivity.

NOTICE Never connect the process fluid lines to your facility water supply or any pressurized liquid source.

NOTICE The pump is capable of producing 0.8 Bar (11.6 Psi). Ensure your plumbing is rated to withstand this pressure at your operating temperature.

NOTICE If the set point is 10°C/50°F or below, a freezing point depressant, such as ethylene glycol, is required. This unit is equipped with a low flow alarm. This feature will shut the chiller down during a low-flow situation to prevent freezing.

NOTICE To avoid permanent damage to the pump and other cooling system components, do not allow the liquid temperature to exceed 60°C/140°F by set-point or other methods. This is the maximum temperature supported by the cooling system.

The LK500 Rack-Mounted Chiller can be operated directly or remotely via the software. Please see the respective chapters for further instructions.

Regardless of whether the chiller is operated in Direct or Remote Operation, please apply appropriate settings on the screen in the Settings Menu for direct operation or via Software. This includes temperature settings, pump speed settings, and fan speed settings.

4.1 Control Panel Functions

The controller controls temperature using a Proportional-Integral-Derivative (PID) algorithm. It is designed with an easy-to-use operator interface.



Figure 14 LK500 Controller Display with Touch Screen

Description of Indicators	
Temperature Display	Displays temperature or set point in °C, K, or °F.
Pressure Display	Displays outputs pump pressure in PSI/bar digitally for a few seconds.
System Status Indicator	Indicates the system status on the main screen. It can indicate the chiller is cooling or heating.
Error Alarm Indicator	The error alarm symbol in the side menu is illuminated to indicate an alarm fault condition.
Fan Speed Set Point	The fan speed has two options, Auto and Max. The fan defaults to automatic mode.
Pump Speed Set Point	The pump speed defaults to Max, or you may manually adjust the pump speed percentage.

4.2 Installing Software

The LK500 Rack-Mounted Chiller Software can be downloaded from the Thorlabs website:

https://www.thorlabs.com/software-pages/lk500

***NOTE:** Do not connect a chiller to the PC during software installation! Please make sure that the installation is carried out completely, including the reboot requests.*

- Save the ZIP file to your computer and unpack the archive.
- Double click the setup.exe to start the Install Shield Wizard.
- Read and accept the End-User License Agreement and the GNU Lesser General Public License.

After installing the Software, connect the chiller to the PC.

4.3 Getting Started

4.3.1 Pre-Start

1. Connect Equipment to Chiller

Please see ***Section 3.4*** to install the chiller and connect to your equipment.

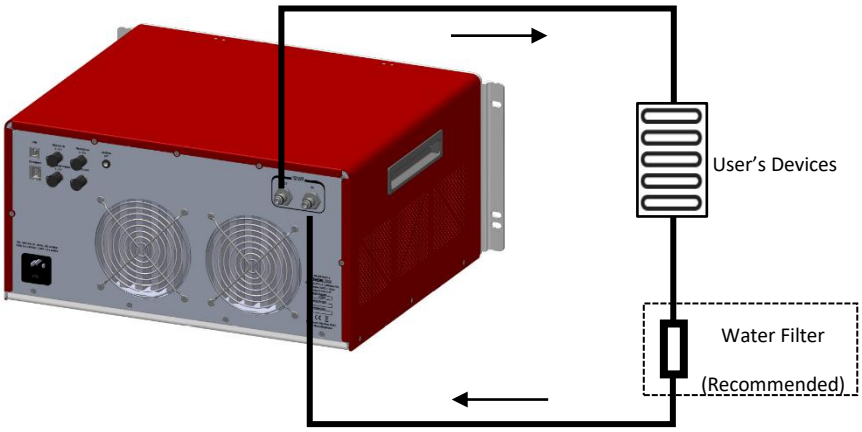


Figure 15 Chiller Loop

Before starting the chiller, double check all electrical and plumbing connections. Ensure the power cord is secured to the rear of the chiller. If the chiller will not start, refer to **Chapter 6 Troubleshooting and Repair**.

2. Connecting an External Sensor

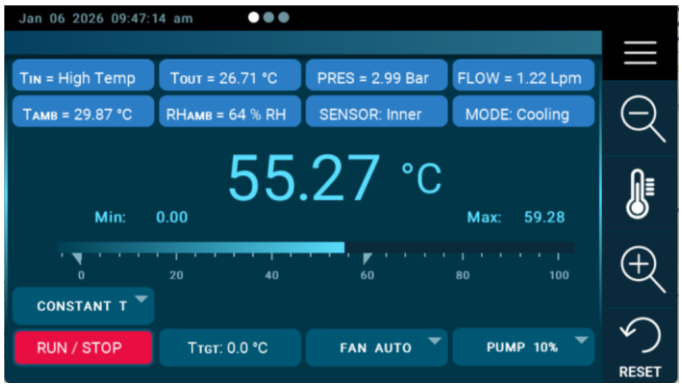
On the back panel of the chiller, there is a 2.5 mm Stereo Jack (9 in **Figure 5**). It is designed to accept a Thorlabs TSP-TH thermistor temperature probe as an external sensor. Other equivalent thermistors soldered with a 2.5 mm Stereo Jack can also be used.

Connect the TSP-TH and toggle the "Sensor Source" in Sensor Operation screen to "EXT". Then, the LK500 will use the external thermistor as the temperature monitor for its temperature control feedback loop instead of the internal thermistor inside the out-coolant hose.

When "Sensor Source" is set to "EXT", the chiller is configured by default according to the parameters of TSP-TH. No additional settings need to be adjusted. To get accurate temperature readings while using other thermistors, the Beta value must be set in the LK500 GUI or software.

4.3.2 Direct Start

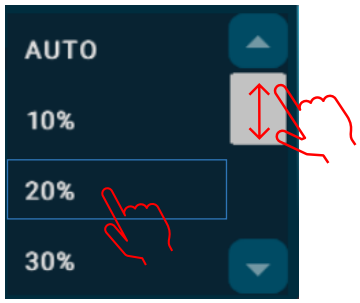
1. See Section 4.3.1 to complete the pre-start.
2. Short press (<3 seconds) the power button (5 in **Figure 4**). The device powers up, recognizes all sensors and is ready for operation within 3 seconds. The power button is illuminated when the device is powered up. The following screen will appear on the display.



3. Press TTGT: 40.00 °C button to enter the set temperature screen; the target temperature and temperature window can be set here. The temperature control window defines the allowed temperature shift of the device. Please note that a warning message appears when the difference between the actual and target temperature is larger than the temperature error window. However, the chiller will continue to run.

4. Configure the LK500 Rack-Mounted Chiller via the Settings Menu on the device according to the setup used, including sensors, target temperature, fan speed, and pump speed. For this, please see the respective chapters on further instructions.

   NOTE: *The default fan and pump of the device are in automatic mode, or you may manually adjust the fan or pump speed percentage.*



5. Press RUN / STOP. The controller does a self-test and then the refrigeration system and the recirculation pump start. The recirculating fluid temperature, pressure the pump operating pressure and flow will display through the GUI.

4.3.3 Remote Start of the LK500 Rack-Mounted Chiller with the Software

1. See Section 4.3.1 to complete the pre-start.
2. Download and install the Software on the device that will be used to control the chiller (PC, laptop). Note: Install the software prior to connecting the chiller to the PC.
3. Short press (<3 seconds) the power button (5 in **Figure 4**). The device powers up, recognizes all sensors and is ready for operation within 3 seconds. The power button is illuminated when the device is powered up.
4. Connect the LK500 Rack-Mounted Chiller to the remote controlling instrument (PC/Laptop) using the USB 2.0 cable or LAN cable.
5. The LK500 Rack-Mounted Chiller is now ready for operation and is recognized by the Software.

6. Configure the LK500 Rack-Mounted Chiller in the software according to the setup used, including sensors, target temperature, fan speed and pump speed. Alternatively, configure the LK500 via the Settings Menu on the device. Please see the respective chapters for further instructions.
7. Start the LK500 Rack-Mounted Chiller. Configuration through the Software or on the LK500 directly are mirrored.

4.3.4 Switch Off LK500

To turn off the LK500 Rack-Mounted Chiller, long press the power button for approximately 1 second until the display briefly shows “Shutting down...". The measurement and device settings will be stored in the device.

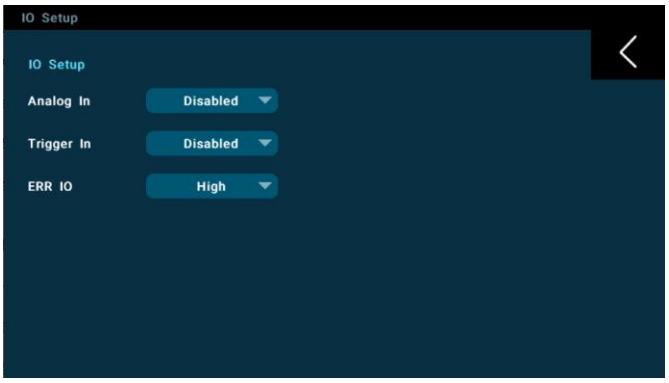
Emergency Shut Down

Pressing the button for more than 3 seconds will perform an emergency shutdown in case of a device hang up. In an emergency shut off, settings will not be stored.

4.3.5 I/O

Select the icon 

to configure the ports.



- **Analog In:** BNC female port provides control of the target temperature from an external signal, 0 V to +3.3 V DC Input corresponds to -5 °C to 45 °C target temperature (default).
- **Trigger In:** BNC female port, High Level (+ 5 V) input to enable the temperature control function of the chiller; Low level (0 V) input to disable the chiller (default).
- **Interlock:** BNC female port, open signal output when the chiller is stopped (default); Close signal output when chiller is running. Close signal output when there are no chiller errors; Open signal output when chiller errors occur.
- **Error Monitoring:** BNC female port, low level (0 V) Input or high level (+ 5 V) DC output indicates whether there are any errors and warnings.

4.4 Direct Operation

The LK500 Rack-mounted chiller can be operated directly on the device without the need for external software. To power up the LK500 Rack-Mounted Chiller, please follow the instructions in ***Chapter 3***. The touchscreen and the physical control buttons on the LK500 Rack-mounted chiller control the device. These controls are redundant and can be mixed as the functions are mirrored within the LK500 Rack-Mounted Chiller. Data can be displayed only or acquired and saved via the Logging measurement screens and saved to the internal 8 GB memory of the LK500 Rack-Mounted Chiller. The saved data can be exported to the connected PC via USB or Ethernet connection. Please see the respective chapters for further instructions.

4.5 Physical Controls

For direct control, the LK500 Rack-Mounted Chiller has five dynamic side menu buttons and a rotary knob, aside from the touchscreen (See **Figure 4**).

Dynamic Side Menu Button

The five buttons refer to the touchscreen elements shown immediately to their left. Pressing the Dynamic Side Menu Button mirrors touching the icon on the touchscreen. The Dynamic Side Menu Button can be configured to beep when pressed via the sub screen Settings in the Settings Menu. The functions of the Dynamic Side Menu Buttons are usually the following (top to bottom).

1. No. 1: Enter  or quit the Settings Menu.
2. No. 2 - 4: Function buttons depending on the interface. You can choose to show Delta/Value Toggle by pushing the 3rd button on the icon . And decreasing the range by pushing the 2nd button on the icon , increasing the range by pushing the 4th button on the icon .
3. No. 5: Reset the value by pushing the 5th button on the icon 

.

Low Light Environment - Dark Screen

The Dynamic Side Menu Buttons are illuminated and dim together with the display after the duration selected in the Setting Menu and Settings Sub-Screen.

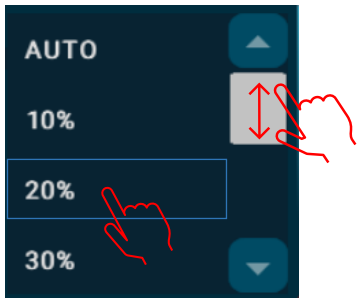
To maximally dim the light for sensitive applications, the button illumination will shut off at a display back-light level of less than 3%.

Rotary Knob

Turning the rotary knob will cycle the focus through all interactive elements on the touchscreen. Short press the rotary knob to select a focused interactive element.

1. **Button**: This toggles between the on and off state of the selected field. 

2. **Drop-down list:** Turn the rotary knob to the desired drop-down element and press again to select and activate the selected element. The drop-down list closes with the activated element.



3. **Selection:** A white line will show around the selected interactive element. Turn the rotary knob to toggle between the selected indicators.
4. **Menu:** A sub-menu is open. Turn the rotary knob now to move through the options and press the rotary knob to select an option and leave the menu.

Special Functions

Screen Off - When the Software is not connected with the chiller, push any button or rotate the knob to activate the screen.

4.6 Touchscreen Operation

The LK500 Rack-Mounted Chiller can be operated via the touchscreen with fingers, with the physical control buttons, or by both combined.

This chapter describes the kinds of active elements on the screen and how to operate them.

The active elements allow easy setting selection from dialog boxes, switches between states, drop-down lists, slider elements, and tab leading to different screens.

Supported Touchscreen Gestures



Figure 16 Slider Control: Pick and Move the Slider

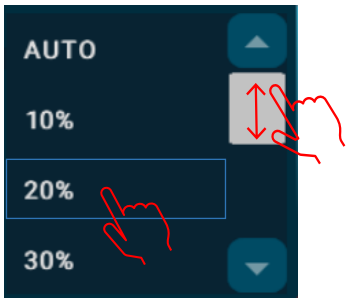


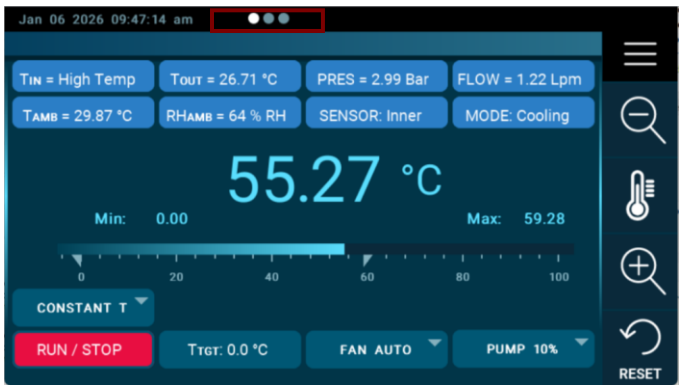
Figure 17 Drop-Down List: Scroll Through a List

4.7 Touchscreen Options and Menu

The touchscreen opens with the last used screen upon power-up. The operating regions "Top Bullets" and "Side Menu" lead to different displays and measurement settings respectively. Shown here is the main control screen.

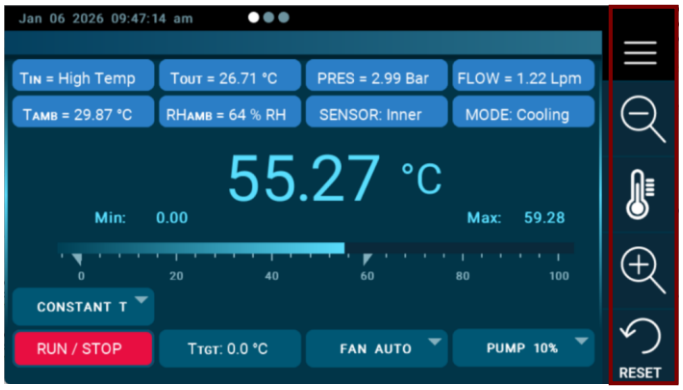
Top Bullets

The top bullets indicate how many screens are activated and available for the configured settings.



Side Menu

Before starting temperature control, you can select the display mode settings for the toggle target temperature display mode. A target temperature display setting is accessible though the side menu. (***See Section 4.1***).



All control settings are accessible through the menu icon in the top right corner . These are described in the individual display screen sections.

4.7.1 Main Control Screens

Three different main control screens for different display modes can be activated and then selected.

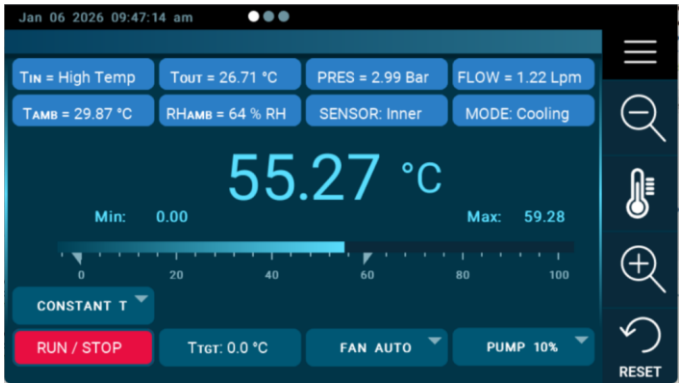
Inactive screens are labeled with a crossed-out eye in the Settings Menu. The bullet bar on top of the display indicates how many measurement screens are available. Other settings are only available when a channel is selected in the Settings Menu.

To move through the panels either swipe horizontally, touch the dots panel, or navigate the dots with the rotary knob: Select the dot field (thin frame), turn the rotary knob to the desired control screen, and press the rotary knob (thick frame) to activate the measurement screen.



Figure 18 Not Selected (Left), Thin Frame (Middle), Thick Frame (Right)

Main Control Screen



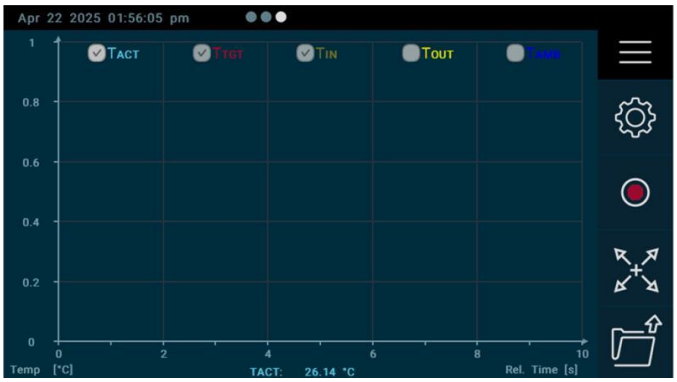
In the default the main display shows the settings and measurement results.

Analog Needle Screen



This display shows the details of the measured temperature.

Logging Screen



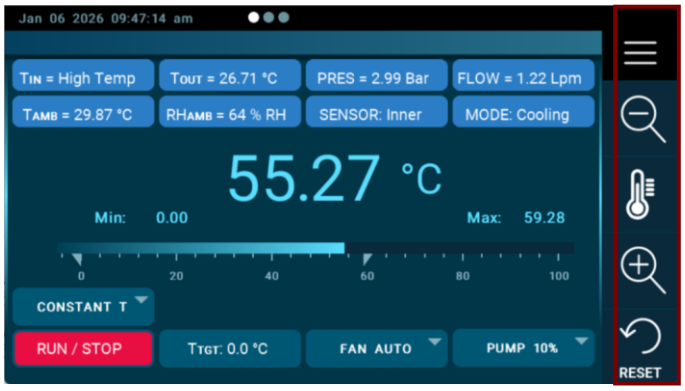
This interface allows the recording of measurement with all temperatures, flow, and pressure.

4.7.2 Control Settings

The control settings can be changed via either of two panels, the full Settings Menu or the Side Menu.

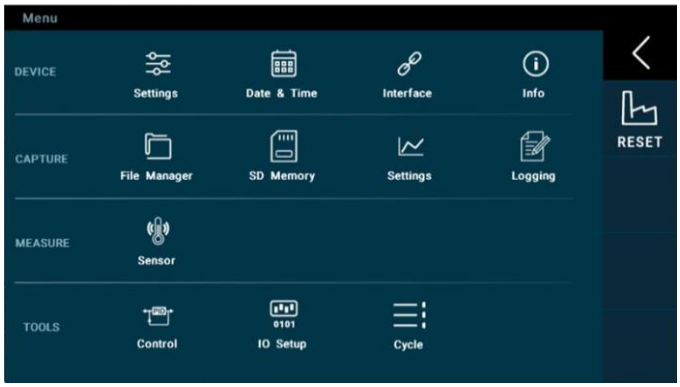
Side Menu

The side menu allows you to change settings quickly during temperature control while simultaneously monitoring the control. The side menu is on the right side of the display screen.



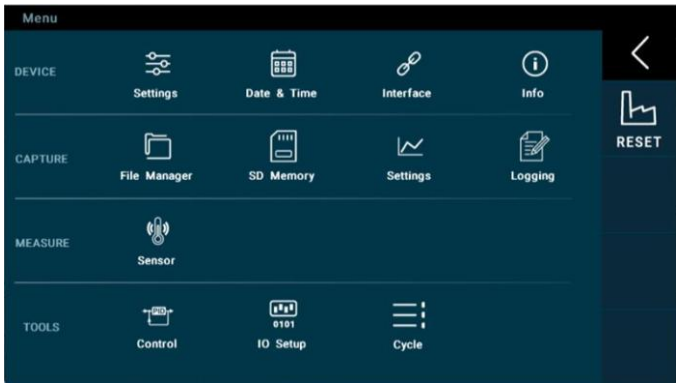
Full Settings Menu

The Settings Menu is best used when initially setting up the measurement as it includes all possible settings. The full settings menu is opened by touching the following menu icon or by briefly pressing the soft button next to it or via the pop-outside menu .



4.7.3 Full Settings Menu

The settings menu shown below leads to all possible settings for a measurement. The following section describes these settings.



Device

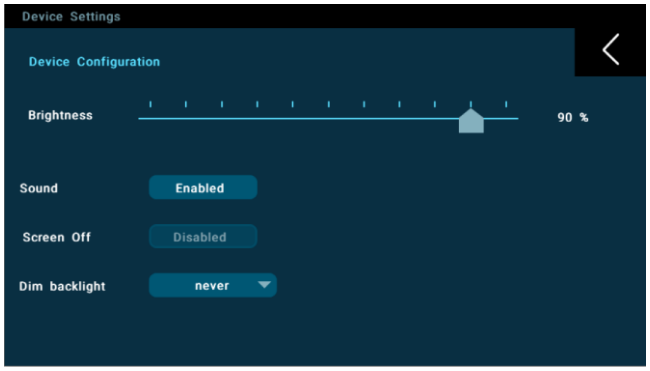
This line leads to:

1. Settings of the Device Itself
2. Date and Time Settings
3. Configuration of the Device Interface via USB or Ethernet

Settings

This panel gives access to the setting language, display appearance and backlight level, key sound. The setting icon 

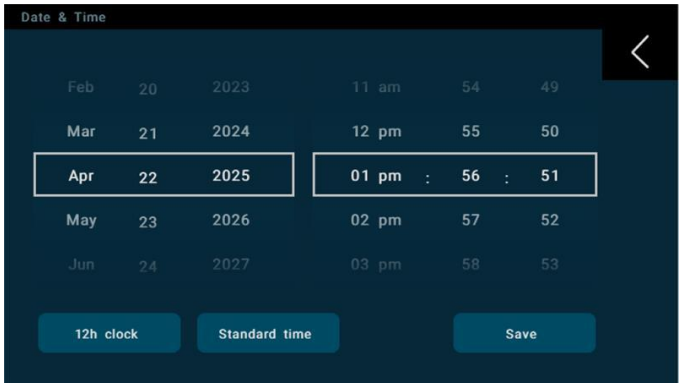
in the Full Settings Menu will lead to this menu. From here you may dim the backlights or configure the screen timeout.



Date/Time

Press the Date/Time menu button 

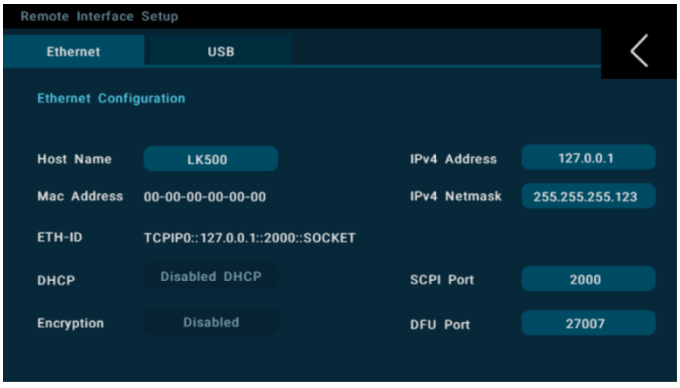
to set date and time.



Interface

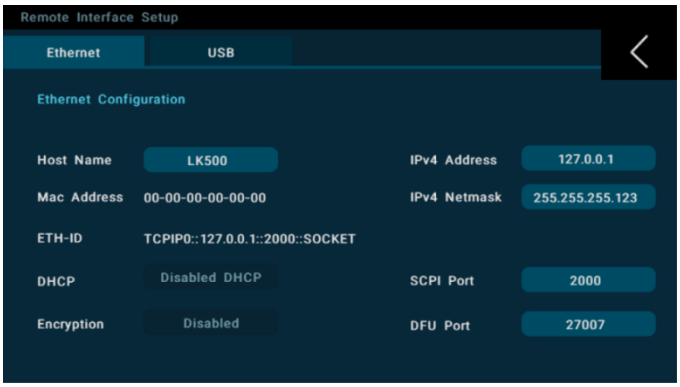
Press the interface menu button 

, the screen provides information on establishing a connection via either the Ethernet connection or USB.



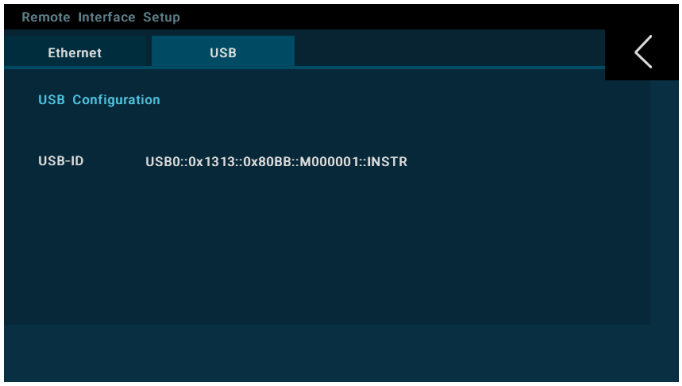
Ethernet

The device comes with a preconfigured host name that can be changed by the user. The Ethernet ID must be used in external programs to establish the device connection. Set ports to 0 to disable access within a network.



USB

This panel shows the resource string information that must be used in external programs to establish the device connection. "0345" is the Thorlabs vendor ID, "8709" is the LK500 product ID, followed by the device serial number.



Info

The info screen shows all relevant device parameters, including firmware versions of all built-in PCBs as well as the backup battery voltage of the real time clock and the free flash memory for data storage.



Capture

This line leads to the settings for:

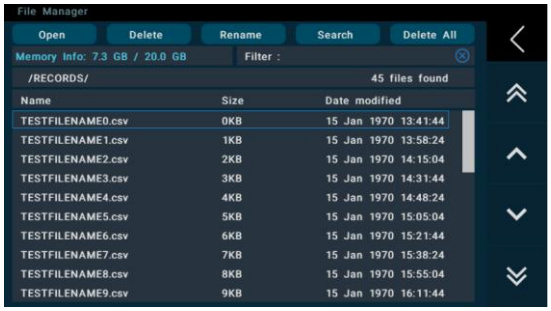
1. File Handling via the File Manager
2. SD Memory: The settings to choose the remote access connections.
3. Setting: Setting the capture mode and interval.

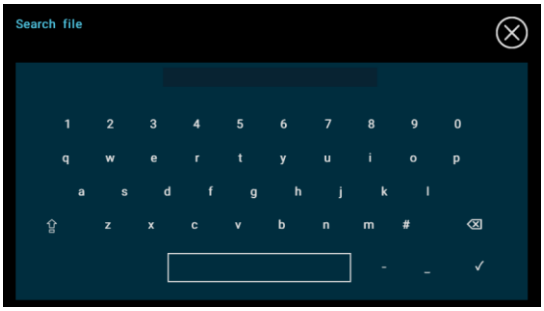
4. Capturing and Recording of Measurements: Logging Screens

File Manager

The file manager shows the folders where respective files are saved. This File manager is also mirrored when the LK500 Rack-Mounted Chiller memory is accessed via the connected PC. The Logging Icon 

in the Full Settings Menu will lead to this menu.





SD Memory

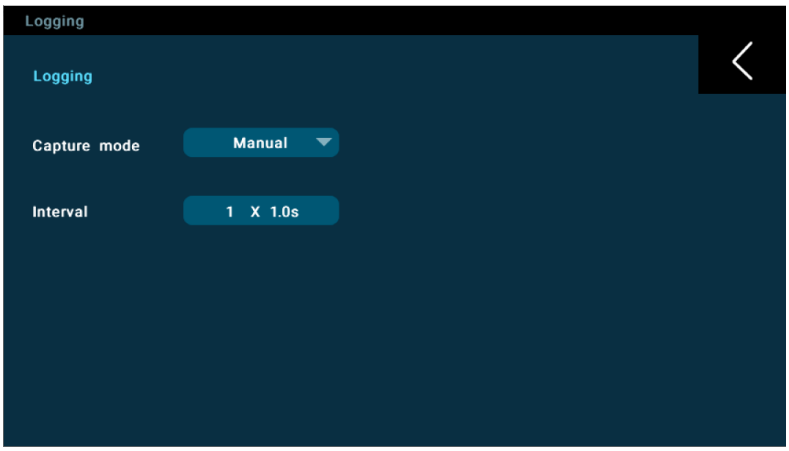
Pressing the memory card menu button 

maps the SD card file system to a connected PC as a USB flash drive, then data can be read on the PC. This requires USB connection.

Settings

Press the settings button 

to edit the capture mode and interval.

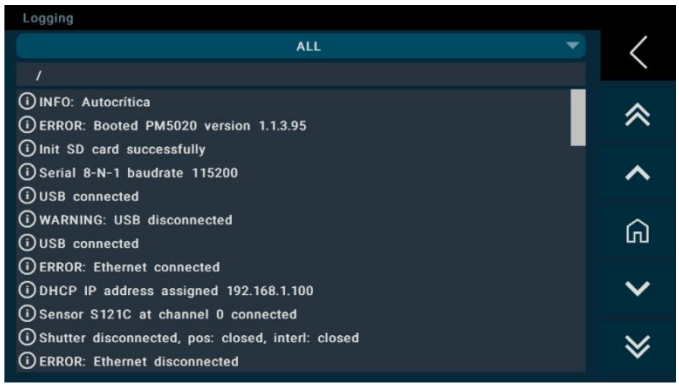


NOTE: *We limit the size of each recording file to a maximum of 100 MB. The longer the data recording interval, the longer the total recording duration. The page displays the maximum recording time achievable with the current interval. If you need a longer recording duration, please increase the recording interval.*

Logging

Shown below are the settings options for measurement logging. The Logging Icon 

in the Settings Menu will lead to this menu.



Please Adjust the Following Here:

- Capture Mode: Mode of Measurement Duration
- Interval: Measurement Resolution
- Environmental Parameters

Measure

This line leads to the settings for the sensor.

Sensor

Press the sensor menu button 

to choose the NTC sensor source. The device defaults to the external sensor source option. If you don't have an external sensor connected when you try to turn on the device, the warning icon and page are displayed and the audible alarm will all sound, you must connect an external sensor or change to inner source and turn on the device again.



Tools

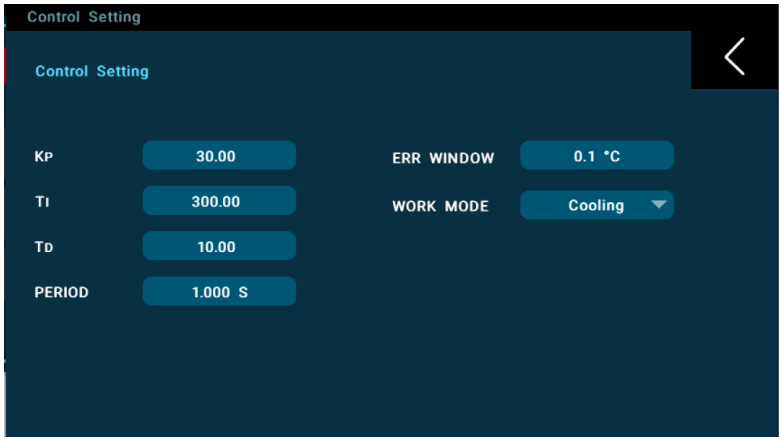
This line leads to:

1. The Control Setting
2. Settings for the I/O Connections

Control Setting

Press the control menu button 

to choose the control mode and set the Proportional-Integral-Derivative (PID) algorithm parameter. You can also choose the working mode Cooling / Heating.



The PID algorithm used in LK500 is described as below, it is a standard form PID.

$$m = K_p \left(e + \frac{1}{\tau_i} \int e\, dt + \tau_d \frac{de}{dt} \right)$$

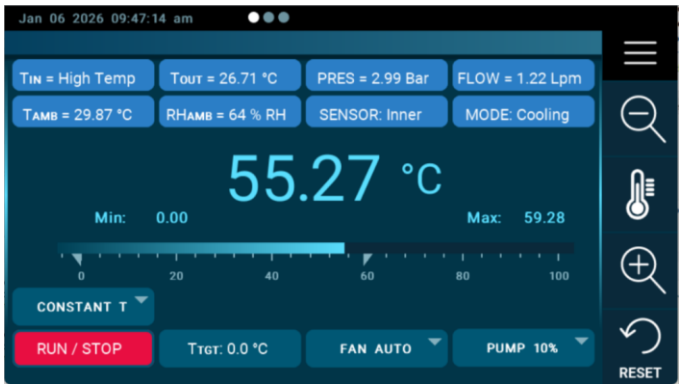
4.7.4 Side Menu

This section describes the functions of the side menu settings which can be adjusted in the different measurement screens.

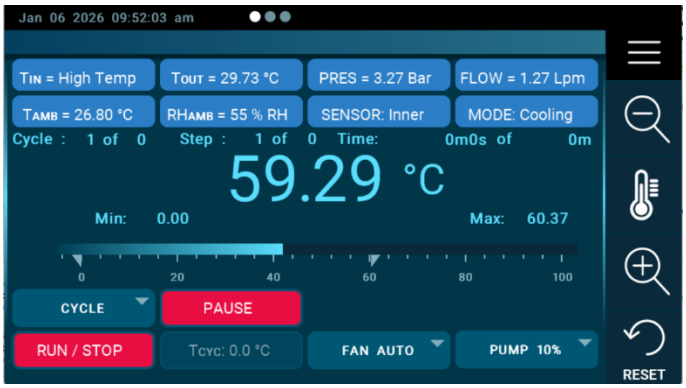
Side Menu Guide		
Main Icon	**Toggle Icon(s)**	**Description**
		Short press to open the Setting Menu which includes all Settings.
		Magnification of Selected Parameter
		Reduction of Selected Parameter
		Sets the actual temperature to true value or manual.
		Resets the Min/Max/(Ratio) values in the analog representations (barograph and needle) and in the optional drop-down.
		Open the Logging setting dialog for recordings. The settings are only available when Logging is stopped. The icon leads to the same display as the Logging settings in the main settings menu.
		Start Logging and Stop Logging
		Magnification / Reduction of Target Temperature
		Open File to Display / Close File
		Scroll Up
		Selected Parameter Up
		Return to the Home Page
		Selected Parameter Down
		Scroll Down
		Restore the Default Settings

4.8 Cycle Mode

NOTICE Do not quickly switch between cooling and heating modes, as it can cause compressor failure. The recommended minimum ramp time is three minutes.

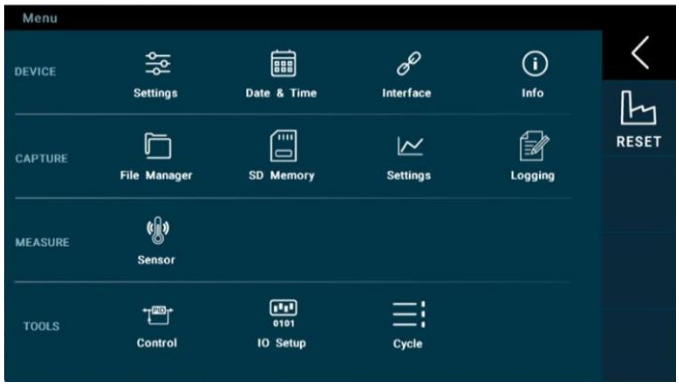


The chiller defaults to CONSTANT T mode



Press 

button to select the CYCLE mode.



Press 

button in the side menu to setting the CYCLE mode.



In CYCLE mode, the user can program one to one hundred distinct temperature levels. The user needs to set the hold temperature and work mode for each step. A “ramp” time can be programmed for each step to determine how long it will take to get from the starting temperature to the stopping temperature. A “hold” time can be programmed to determine how long the system will stay at the stopping temperature before moving on to the next step.



During the course of any step, CYCLE Mode can be paused, press PAUSE button to stop the ramp or hold timers at their present count. Removing the paused function will resume the cycle at the same point at which it was paused.

4.9 Remote Operation

The LK500 Rack-Mounted Chiller can be remote controlled via two different interfaces: the high-speed USB Interface or the built in Ethernet. The chiller Software remote operation can be integrated into custom made systems with the help of the provided SCPI commands and drivers via the USB ports.

In addition, the chiller has a built-in Webserver such that measurements can be monitored via the Ethernet connection in the web viewer.

4.9.1 LK500 Rack-Mounted Chiller Software

The LK500 Rack-Mounted Chiller Software provides a Graphical User Interface to view, log data and can be used when the chiller is connected via USB or Ethernet connection. Download the Software package from the Thorlabs website via this **link**, through the software tab on the product website, or through searching for the product name on the **Thorlabs software guide**.

NOTE: *Do not connect to the LK500 prior to software installation!*

ATTENTION: *Exit all running applications on your PC as the installer may require a reboot of your PC during installation!*

Software Requirements

The software for remote operation of the LK500 chiller requires PC hardware and software environment as specified on the software website. The PC can be connected to either via USB or the Ethernet connection on the LK500 chiller.

Interfaces

The LK500 Rack-Mounted Chiller can be connected to a PC or network using the Ethernet connection or USB connection. Use the Ethernet connection to view the measurement via a web browser on a remote PC. Use USB for remote control of the LK500 chiller. The USB and Ethernet connection can be used to connect the LK500 chiller to the software and to transfer files such as screenshots to a PC.

Ethernet Operation

Connect the chiller using the RJ45 Ethernet connector on the back panel.

Go to the Settings Menu and open the submenu Interface 

.

The below screen "Ethernet" provides information to connect the chiller to the network.

The device comes with a pre-configured host name that can be changed by user. The Ethernet ID must be used in external programs to establish the device connection.



Set ports to 0 to disable access within a network. Once this connection is established, the user can access the web viewer as described in the respective chapter or control the chiller via the software.

Data Export

Data can be accessed via a connection to a PC via the USB connection.

Temperature curves, screen shots, or recorded via the Logging feature and the SCPI commands to write a custom-made application are saved on the LK500 internal memory and can be conveniently viewed in a web browser.

1. Connect the LK500 to a PC using the USB cable.
2. Touch the icon SD Card in the Settings Menu 

. This connects the LK500 chiller to the PC.
3. A new removable disk will appear on the connected PC.
4. Open the subfolder of interest to access the data.

4.9.2 Custom Software

The LK500 Rack-Mounted Chiller remote operation can be integrated into custom-made systems with the help of the provided SCPI commands and drivers. The SCPI commands are saved on the LK500 internal memory and can be conveniently viewed in a web browser.

1. Connect the LK500 to a PC using the USB cable.
2. Touch the SD Card icon in the Settings Menu 

. This connects theLK500 chiller to the PC.
3. A new removable disk will appear on the connected PC.
4. Open the subfolder "support docs" in a web browser (for example Edge, Firefox). This .html file contains all the information required to write a custom-made application.

For the chiller drivers, please either use NI-Visa drivers possibly already installed on the PC or use the Thorlabs TLP drivers which are installed with the LK500 Chiller Software.

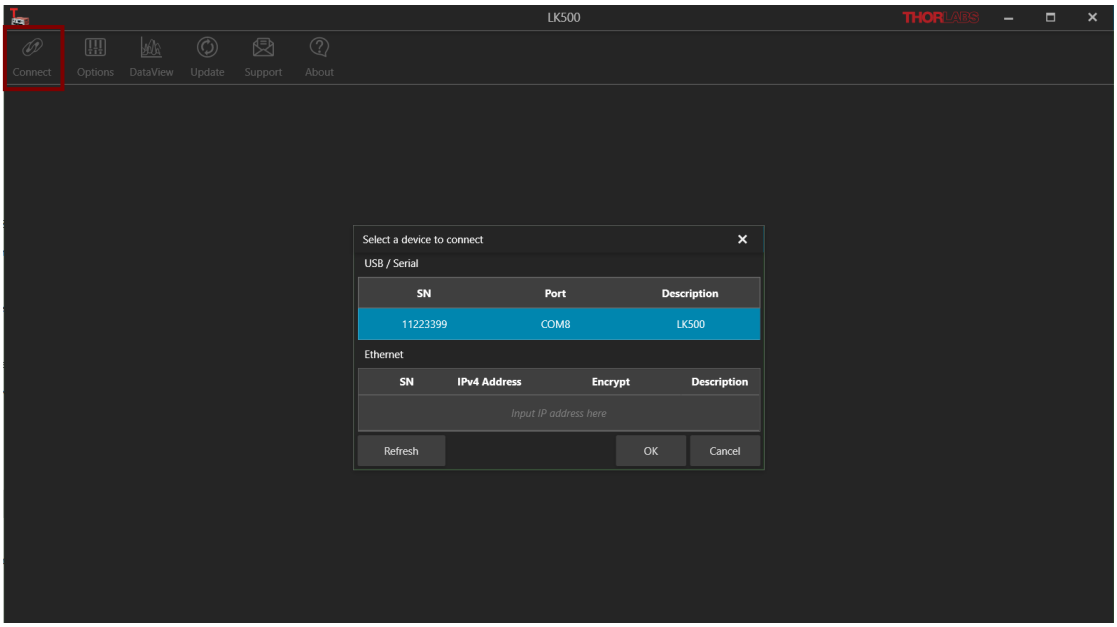
4.9.3 Firmware Update

The LK500 chiller may require firmware updates as they become available for improved capabilities & bug fixes.

Refer to the LK500 page on the Thorlabs website for more details.

4.10 Launching the Software

After launching the software, click “Connect” to list available devices. Multiple devices may be controlled at a time.



4.10.1 User Control



The user control GUI duplicates all front panel functions, including target temperature, actual temperature readouts, pump speed, fan speed, and PID settings. Both the front panel controls and software GUI can be enabled at the same time and will constantly read the unit status and update their displayed information accordingly. The software can also be used to manage files, capture logs, and export data.

4.10.2 Sequence Mode



This software GUI provides a tool to generate an operation sequence for temperature control.

4.10.3 Cycle Mode



The Cycle mode GUI duplicates all local cycle functions.

Chapter 5 Maintenance and Cleaning

DANGER Always disconnect power to the chiller when performing maintenance. Failure to do so could result in damage to the equipment, personal injury, and/or death.

WARNING A qualified service technician must perform all service and maintenance internal to the chiller. Unqualified individuals conducting service on the chiller could result in damage to the equipment, personal injury, and/or death.

NOTICE Handle the chiller with care. Sudden jolts or drops can damage its components.

5.1 Inspections

After your Thorlabs Rack-Mounted Chiller is up and running, it takes only a small amount of care and maintenance to keep it running well.

Every installation is unique, and the operating conditions determine how often the equipment should be inspected and maintenance be performed. The following are some guidelines.

5.1.1 Weekly Inspections

- **Noise Level**

  Any abnormal sounds or a substantial increase in noise level since the last weekly inspection may indicate the following: impending pump, fans, or coolant blockage problem. Investigate the cause and perform the necessary service. Refer to the troubleshooting guide in this manual.

- **Leakage**

  If you notice coolant on the floor near the chiller or dripping from the chiller enclosure turn off the chiller. Disconnect the power cord. Find and repair any leaks immediately.

- **Coolant Level**

  Any significant drop in the coolant level should be investigated further. If there is no visible system leak, then the loss may be due to equipment leakage elsewhere.

- **Pump / Motor**

  No maintenance is required on the pump. Listen to any abnormal sounds. As a precaution, the pump must be periodically replaced. This will avoid damaging the unit and the cost associated with excessive downtime.

- **Fan Assembly**

  No maintenance is required on the fan. Listen for any abnormal sounds.

- **Water Filter**

  With a new system the filter quickly accumulates foreign matter introduced during system setup. This can lead to a decrease in system performance in a short period of time. Inspect the filter cartridge one day after you set up a new system to ensure the filter is clean and the system runs at maximum capacity. After this initial filter inspection, check the filter weekly.

  Periodically inspect and clean the filter. If it becomes fouled the flow rate will decrease and the pump may wear prematurely. The filter can be cleaned by rinsing it in warm water and brushing it gently. For a detailed procedure in cleaning the filter or replacement filters visit the website at ***www.thorlabs.com.***

- **Control Box Fuse Replacement**

  This fuse is an internal inline fuse to the control box and should only be replaced by a qualified technician. Open the inline fuse holder (just below 7 in **Figure 5**) on the back panel to remove the blown fuse and insert a new fuse. Use a 5x20 mm time lag fuse 6.3A 250V (SCHURTER P/N 0034.3125) or equivalent.

5.1.2 Periodic Inspections

- **Low Level Switch**

  The level switch protects the pump in the event of accidental fluid loss. Since this switch is "passive" during normal operation, it is advisable to check it at least on a semiannual basis. Drain the coolant to see if the low-level alarm is activated.

- **Hoses**

  Inspect and tighten the chiller's external hoses and clamps on at least a semiannual basis.

- **Algae**

  Thorlabs recommends the use of an algae inhibitor to prevent growth in the reservoir.

- **Condenser Fin**

NOTICE Directing airflow at the condenser fins at an angle may result in bending/damage of the condenser fins, resulting in decreased condenser performance.

For maximum performance the condenser fin should be free of dust and debris. To clean the condenser, follow the steps below. All work should be performed while wearing safety glasses and ear protection with the chiller powered off.

1. Remove the Red Cover
2. Remove the cable and any duct work covering the condenser.
3. Attach an air nozzle to a compressed air source regulated to between 50 and 100 psi.
4. Direct the air at the face of the condenser in the opposite direction the fan blows. Keep the nozzle 2 to 4 inches from the face of the condenser. The air flow should be very close to perpendicular to the face of the coils.
5. Sweep the air flow back and forth across the face of the coil to remove any excess contamination which would have built up during use until clean.
6. Reattach the cable and any ducting.

- **Cleaning the System and Reservoir**

To clean the system, follow these steps below.

1. Drain the entire chiller including the hoses and equipment being cooled.
2. Replace the coolant with clean water.
3. Run the unit with the clean water for 15 minutes.
4. Drain the chiller again.
5. Clean or replace the in-line filter.
6. Refill the chiller with new coolant.

5.2 Draining Procedure for Thorlabs Rack-Mounted Chillers

⚠CAUTION A container should be available to hold the fluid removed from the chiller. This container should be labeled in accordance with OSHA rules and regulations concerning handling of the fluid being removed from the chiller. Failure to do so could result in personal injury.

⚠CAUTION Reference the MSDS sheet for the fluid being removed from the chiller for further handling, storage, and disposal instructions. Disposal of fluid removed from the Thorlabs Rack-mounted chiller should be in accordance with all Local and Federal disposal laws. Failure to do so could result in personal injury.

NOTICE

Not following this procedure may result in extensive damage to the chiller. It is extremely important to completely drain the chiller when not in use for extended period of time, shipping outside of its current location, during certain repairs, and for scheduled fluid maintenance. Failure to fully drain the system could result in damage to the equipment. Thorlabs recommends method #1 as the most efficient way to remove fluid from the chiller.

5.2.1 Method #1 - Recommended

1. Thorlabs recommends using a wet vac to thoroughly remove fluid from the chiller. Remove the plastic cap from front of the clean fluid reservoir. Vacuum this tank until it is completely free of any fluid. Keep the reservoir cap removed from reservoir until step #5.
2. Attach CPC® Valved Thumb Latch Quick-Disconnect body fittings to the "IN" and "OUT" fitting located at the rear of the chiller and connect them with a hose. Then, use CPC® Valved Thumb Latch Quick-Disconnect coupling insert fitting to connect to the "DRAIN" fitting located at the front of the chiller. Drain most fluids from the "DRAIN" fitting. (Note: A container should be available to hold the fluid removed from the chiller).
3. Using a wet vac, vacuum the "DRAIN" connection until all the fluid has been removed from the drain side.
4. After all the fluid has been removed from the drain side, move the vacuum to the "OUT" connection. Vacuum this connection until all fluid has been removed. (Note: make sure the reservoir cap is removed, allowing air to enter system)
5. Install the plastic cap plug into the reservoir.

5.2.2 Method #2 - Without Access to a Wet Vac

1. Remove the plastic cap from the front of the clean fluid reservoir. Keep the reservoir cap removed from the reservoir until step #4.
2. If possible, elevate the chiller approximately 1 meter off the ground. This will allow you to drain the system into a bucket.
3. Use CPC® Valved Thumb Latch Quick-Disconnect body fitting connected to the "IN" and "OUT" fitting located at the rear of the chiller to connect the water pipe circuit of the entire unit to a tank of compressed air. We recommend purging the outlet and inlet with compressed air, which allows the coolant from the water pipe to drain almost completely from the reservoir.
4. Install the plastic cap plug onto the reservoir.

5.3 Coolant Maintenance

5.3.1 Recommended Coolant for Use in Thorlabs Rack-Mounted Chillers

- Thorlabs offers non-toxic Coolflow DTX Refrigerant Antifreeze with Corrosion, Scale, and Biological Inhibitors for use with chillers.
- Do not use automotive antifreeze as the rust inhibitors may cause premature failure of the pump seals.
- Avoid using water with a high mineral content.

- If the chiller is exposed to sunlight, add an algaecide to control organic growth in the coolant. A mixture of 30% Ethylene or Propylene Glycol can also be used to control algae growth.

5.3.2 Checking Coolant Level

- There is a coolant level indicator on the front of the chiller. Coolant should be added as soon as this indicator approaches the "L" indicator line.
- Reducing the coolant volume may reduce the chiller's cooling capacity.
- Inspect coolant level weekly or whenever the chiller is powered on.

5.3.3 Flush & Replace Coolant Periodically

⚠WARNING In order to avoid electric shock, be sure to wipe up all fluid spills in the unit before applying electrical power. Failure to do so could result in damage to the equipment, personal injury and/or death.

- Depending on the environmental conditions, the coolant should be flushed and replaced as necessary, depending on the amount of particulate matter that has been found in the system during planned maintenance inspections.
- If the water filter and coolant are found to have little or no contamination after the first inspection, replacing the coolant and cleaning the strainer can be done less frequently.
- When the strainer is cleaned or replaced, the electrical power must be disconnected at the power inlet located at the rear of the chiller.

5.4 Compressor Refrigeration Module Maintenance

⚠WARNING Recycling R290 refrigerant is subject to local environmental protection regulations, therefore the refrigerant must be evacuated from the compressor refrigeration module prior to disposal of the assembly.

⚠CAUTION Skin contact with refrigerant may cause frostbite.

The compressor refrigeration module is a sealed unit and does not require regular maintenance to operate. Depending on environmental conditions the condenser fins could become fouled with dust and debris. A fouled condenser will cause the module to operate inefficiently and potentially shut down. To clean the condenser, please see ***Section 5.1.2***.

The module contains R290 as a refrigerant. In the event that the compressor refrigeration module is damaged, general work clothing, leather gloves, and eye protection should be worn to prevent exposure to refrigerants.

Disposal of R290 must comply with federal, state, and local disposal or discharge laws.

Chapter 6 Troubleshooting and Repair

6.1 Error Codes

Several different errors may occur during chiller operation. These errors are displayed on the front LCD screen of the system. See below for an explanation of each error.

When an error occurs, the device will stop operating.

Err 00 - Low Liquid Level

This error indicates a low fluid level in the reservoir. The chiller controller will shut down the pump, compressor, heater, and fan. Refilling the coolant (not refrigerant) will clear the fault. See Section **6.3** for troubleshooting suggestions.

Err 01 - Compressor Fault

The compressor has encountered a running fault. See Section **6.3** for troubleshooting suggestions. If the issue persists, please contact your local Thorlabs Technical Support office.

Err 02 - Pressure Fault

This error indicates that system pressure is missing or insufficient. See Section **6.3** for troubleshooting suggestions. If needed, please contact your local Thorlabs Technical Support office.

Err 03 - Flow Fault

This error indicates that coolant flow is missing or insufficient. See Section **6.3** for troubleshooting suggestions. If needed, please contact your local Thorlabs Technical Support office.

Err 04 - Actual Temperature is Missing

This error indicates that the actual temperature sensor signal is missing. Possible causes include a disconnected, cut, or short sensor wire, or an internal transducer failure. Please contact your local Thorlabs Technical Support office.

Err 05 - Actual Temperature Too High (Heating Mode)

This error indicates that the actual temperature exceeds 60°C.

Err 06 - Inlet Temperature Too High (Heating Mode)

This error indicates that the inlet temperature exceeds 60°C.

Err 07 - Outlet Temperature Too High (Heating Mode)

This error indicates that the outlet temperature exceeds 60°C.

6.2 Warning Codes

Several different warnings may occur during chiller operation. These warnings are displayed on the front LCD screen of the system. See below for an explanation of each warning.

When a warning occurs, the device continues to operate normally.

Warn 00 - Ambient Temperature is Missing

This warning indicates that the ambient temperature sensor signal is missing. Possible causes include a disconnected, cut, or short sensor wire, or an internal transducer failure. Please contact your local Thorlabs Technical Support office.

Warn 01 - Ambient Humidity is Missing

This warning indicates that the ambient humidity sensor signal is missing. Possible causes include a disconnected, cut, or short sensor wire, or an internal transducer failure. Please contact your local Thorlabs Technical Support office.

Warn 02 - Inlet Temperature Too Low

This warning indicates that the inlet temperature falls below -10°C.

Warn 03 - Inlet Temperature Too High (Cooling Mode)

This error indicates that the inlet temperature exceeds 60°C.

Warn 04 - Inlet Temperature is Missing

This warning indicates that the inlet temperature sensor signal is missing. Possible causes include a disconnected, cut, or short sensor wire, or an internal transducer failure. Please contact your local Thorlabs Technical Support office.

Warn 05 - Outlet Temperature Too Low

This warning indicates that the outlet temperature falls below -10.

Warn 06 - Outlet Temperature Too High (Cooling Mode)

This error indicates that the outlet temperature exceeds 60°C.

Warn 07 - Outlet Temperature is Missing

This warning indicates that the outlet temperature sensor signal is missing. Possible causes include a disconnected, cut, or short sensor wire, or an internal transducer failure. Please contact your local Thorlabs Technical Support office.

Warn 08 - Heat Sink Temperature is Missing

This warning indicates that the heat sink temperature sensor signal is missing. Possible causes include a disconnected, cut, or short sensor wire, or an internal transducer failure. Please contact your local Thorlabs Technical Support office.

Warn 09 - Heat Sink Temperature Too High

This warning indicates that the heat sink temperature exceeds 60 °C. In this case, the compressor's cooling power will be reduced.

Warn 10 - Actual Temperature Above Error Window

This warning indicates that the actual temperature is above the allowable error window.

Warn 11 - Actual Temperature Below Error Window

This warning indicates that the actual temperature is below the allowable error window.

6.3 Troubleshooting Guide

Troubleshooting Guide		
Problem	**Possible Cause**	**Recommended Remedy**
Unit Does Not Start or Shut Off Shortly After Starting	No power to the unit, circuit breaker off or tripped.	Make sure the unit is plugged in. Verify power to the unit. Turn on the unit with the Power (⏻) key on the keypad. Check the main power fuse (see Maintenance & Repair section).
	Low flow and Low-Pressure shut off will cause the chiller to stop after starting.	Fill the external line prior to starting up. Pump is not Primed. See **Chapter 3**.
	Low Voltage.	Have a qualified electrician check the electrical service to the unit.
	The controller set point temperature is too high.	Reset the set point to the proper temperature.
	Condenser coiled with dust or debris.	Remove the lower grill and vacuum the coil face clean.
Chiller Shuts Down During Operation	Auto alarm has tripped.	Check if an error is displayed on the LCD screen.
	Circuit breaker off or tripped.	Make sure the unit is plugged in. Verify power to the unit.
Excessive Noise on Startup	Liquid refrigerant in the suction line to the compressor.	This should go away after the system runs for a few minutes.
Noisy Compressor	Low voltage or wrong voltage to unit.	Verify power source; check electrical service.
	Unit stored in cool environment for a long period may have collected liquid refrigerant in the compressor.	This should go away after the system runs for a few minutes.
Noisy Pump Motor / Pump Motor Overheats	The pump is worn out.	Replace the pump with a new one. Please contact your local Thorlabs Technical Support office for help.
	Improper voltage to the system.	Verify and correct the voltage to the chiller.
	Obstruction in pump head.	Shut down unit, clear obstructions and restart unit
Actual Temperature No Sensor	No external sensor is connected.	Please connect the external thermistor or change the control sensor to the internal sensor.
	The target sensor is damaged.	Replace the sensor with a new one.

Troubleshooting Guide		
Problem	**Possible Cause**	**Recommended Remedy**
Audible Alarm Stays On	Low level in reservoir.	Fill more coolant to reservoir.
	The level switch is stuck.	Clean the reservoir and level switch.
	The level switch is damaged.	Replace the level switch with a new one. Please contact your local Thorlabs Technical Support office for help.
	Set point temperature is too close to the temperature alarm.	Adjust the set point.
	High temperature alarm is set too close to cooling temperature set point.	Adjust high temperature alarm set point.
Pressure Error / Flow Error	Water filter dirty or clogged.	Change or clean filter cartridge and reassemble.
	Low coolant level or no coolant in the reservoir.	Check for leaks. Repair any leaks and fill reservoir.
	Restriction in coolant lines external to the chiller.	Eliminate restrictions on the lines. Open any valves.
	Pump overload has tripped.	Turn unit off. Wait for the overload to cool. It will reset on its own in 30 minutes or less.
	Leaks in external piping.	Check for leaks. Repair any leaks.
	Damaged sensor.	Short circuit (directly connect) the inlet and outlet. If there is still low coolant flow/pressure. Please contact your local Thorlabs Technical Support office for help.
	Damaged Pump	Short circuit (directly connect) the inlet and outlet. If there are still low coolant flow and pressure. Please contact your local Thorlabs Technical Support office for help.
	Pressure drop through system is too large.	Short circuit (directly connect) the inlet and outlet and check the pressure. If the flow returns to normal, please use either larger hoses or a shorter line length to reduce the pressure drop to equipment to be cooled.

Troubleshooting Guide		
Problem	**Possible Cause**	**Recommended Remedy**
Compressor Protection	Compressor module software overcurrent.	After entering the protected state, completely disconnect the power supply (including AC power) and restart after at least three minutes. If it doesn't work, please contact your local Thorlabs Technical Support office for help.
	Compressor module hardware overcurrent.	
	The compressor is out of phase.	
	Compressor phase current is abnormal.	
	Compressor stall or startup.	
	Compressor module overvoltage / low voltage.	
	Compressor communication is lost. (Comp Error: No com).	

Chapter 7 Command Line Operation

The LK500 remote operation can be integrated into custom-made systems with the help of the provided SCPI commands and drivers via USB ports. For LK500 drivers, please either use NI-Visa drivers possibly already installed on the PC or use the Thorlabs TLP drivers which are installed with the LK500 Software.

Please see the files in the SD card of the LK500 for command line details.

Chapter 8 Software GUI

Software enabling remote control of the unit is available for downloading from the Thorlabs website. After installing the software package and connecting the host PC to the unit via the high-speed USB Interface or the built in Ethernet on the back panel, the PC can control the chiller using either a GUI or through a command-line interface, as discussed in **Chapter 4** and **Chapter 7.**

The software GUI and front panel controls are enabled at the same time. The GUI's controls duplicate all front panel functions (e.g., target temperature, actual temperature, pump speed, fan speed, etc.), both constantly read the unit status and update their displayed information accordingly. (e.g., any adjustments made to the pump speed using the front panel is registered by and used to update the status of the GUI).

LK500 Software GUI - Hardware Requirements

- Processor (CPU): ≥1 GHz
- Memory (RAM): 2 GB
- Hard Drive: Min 25 MB of Available Disk Space
- Interface: Free USB 2.0 Port, Free USB 3.0 Port, RJ45 Ethernet Connector

The Software is Compatible with the Following Operating Systems:

- Windows® 10 64-Bit version Operating System

- Windows® 11 64-Bit Operating System

Chapter 9 Disposal



Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return “end of life” Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out “wheelie bin” logo (see right), were sold to and are currently owned by a company or institute within the EC and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. “End of life” units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site. It is the user’s responsibility to delete all private data stored on the device prior to disposal.

Chapter 10 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at www.thorlabs.com/locations for our most up-to-date contact information.



Corporate Headquarters
Thorlabs, Inc.
43 Sparta Ave
Newton, New Jersey 07860
United States

sales@thorlabs.com
techsupport@thorlabs.com

Product Manufacturer
Thorlabs China
Room A101, No. 100, Lane 2891,
South Qilianshan Road, Putuo District
Shanghai 200331
China

chinasales@thorlabs.com
techsupport-cn@thorlabs.com

EU Importer
Thorlabs GmbH
Münchner Weg 1
D-85232 Bergkirchen
Germany

sales.de@thorlabs.com
europe@thorlabs.com

UK Importer
Thorlabs Ltd.
204 Lancaster Way Business Park
Ely CB6 3NX
United Kingdom

sales.uk@thorlabs.com
techsupport.uk@thorlabs.com



THORLABS

www.thorlabs.com