LTC302 Temperature Controller

Operating Manual

LTC302 Temperature Controller

1.1 Introduction

The LTC302 temperature controller has been designed for high precision operation of Diode Lasers in spectroscopic application. The greatest emphasis was placed to the stable and safe operation of the laser diode. Therefore it is based on the leading edge components and is provided with a number of safety systems. The LTC302 is perfectly suited to work with popular temperature sensors: NTC 10kΩ thermistor, AD590 and LM35. However, the best temperature stability could be obtained with the NTC 10kΩ sensor which is included in the LTC302 set.

1.2 Front panel

1. AC Power key switch
2. OLED graphic display
3. View / Down switch – changing information on the display / decrementing values in the setup menu.
4. Opens setup menu to set up the controller settings (signalized by green LED)
5. Scale / Up switch – changing plot scale in chart mode / incrementing values in setup menu
6. Stabilization START / STOP switch, The red LED signalize the operation
7. Multi-turn Temperature setting knob
8. 9 - PIN laser connector

1.3   Basic operation

The LTC302 Temperature Controller is designed to precisely control the temperature of diode laser with using Peltier thermoelectric cooler (TEC). The required temperature T_{SET} is set by regulation knob (7) and is displayed on the display (2). The laser head temperature is measured by one of the compatible temperature sensors and is displayed as T_{ACT}. These two signals are subtracted and the resulting differential signal ΔT (T_{ACT} - T_{SET}) is used by an analog, high precision PID controller for temperature regulation. The PID controller output is amplified and the regulation current is delivered to TEC via 9-pin connector.

1.4   The first use in the new setup

a. A proper temperature sensor has to be selected (see section 2.1).

b. The key controller parameters has to be set (see section 2):

- the initial value of Proportional and Integral factor
- maximum value of TEC current
- maximum / minimum temperature – ALARM threshold
- maximum / minimum temperature – STOP threshold

c. The desired laser temperature T_{SET} must be set

d. Temperature regulation should be enabled by pressing on/off switch (6) and the temperature change has to be observed, whether it is going in the right direction. If not, the Regulation Logic must be changed (see section 2.3)

1.5   The OLED Display

The LTC302 Temperature Controller is equipped with high quality OLED Display witch presents all important control data and parameters. There are four modes of its operation which could be changed by pressing View Switch (3).

I.

Shows desired T_{SET} temperature and actual laser temperature T_{ACT}.

II.

The same as above plus precisely measured temperature difference $\Delta T = T_{ACT} - T_{SET}$ is shown. Additionally the magnitude of Integration component of the PID regulator is monitored. It could be useful while adjusting the parameters of the PID controller.

III.

In this mode, a graph of the temperature error (ΔT) evolution is presented. The one of the three ranges (±3mK, ±30mK, ±300mK) of Y-axis could be selected by pressing RANGE switch (5). The current range is displayed in the upper left corner of the screen. The initial scale of X-axis is 4 points / second and could be slowed by factor 1..20 in the setup menu.

IV.

Mode similar to the previous one, but the graph is stretched to the full screen. This mode is also used as a screen saver that protects the screen against a burning off constantly displayed elements of the interface.

2   Controller Settings

Most of the LTC302 controller configuration could be done in the setup menu.

The exception is running the LM35 sensor or changing the Regulation Logic. In these cases positions of some jumpers on PCB of the controller have to be changed. Please disconnect the main AC power plug before you open the controller cover!

2.1   Temperature Sensors

The LTC302 Temperature Controller is capable to work with one of three popular temperature sensors: NTC10kΩ thermistor, AD590 and LM35. Due to the noise performance the best temperature stability will be obtained by using 10kΩ thermistor. Therefore this sensor is recommended for use and it is supplied with the controller.

The selection of NTC10KΩ and AD590 can be done in the setup menu, whereas selecting the LM35 sensor has to be done by both: changing in the setup menu and reconfiguring jumpers inside the controller.

	JP3	JP4	JP5
AD590	OPEN	OPEN	Short: 1-2
LM35	Short	Short	Short: 2-3

2.2   PID Controller

The high temperature stability could be obtained when Proportional and Integration parameters of PID controller are selected correctly to the controlled object.

These parameters are set in the setup menu within range of 0÷255. The LTC302 controller comes with predefined settings for a typical diode laser head.
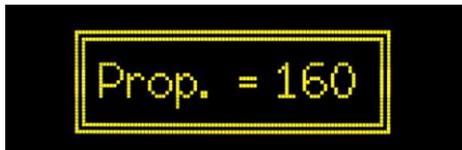
2.3   Regulation Logic

Depending on the applied cooling / heating element a proper Regulation Logic POSITIVE or NEGATIVE should be selected. It determines the response of the controller to the sign of the temperature error. When firstly connected to the new setup, the temperature change has to be observed carefully, whether it is going in the right direction. If not, the Regulation Logic must be changed into opposite. It is done by changing the position of jumper JP1 (to be found on the controller's PCB).

2.4   TEC Output Current

The output current of the TEC element could be limited if necessary.

The maximal current value is set in the Setup Menu.

2.5   Safety Settings

To prevent excessive rise or fall of temperature of the laser a temperature safety system has been implemented. There are two levels of the protection: Temperature Alarm and Emergency Stop Temperature. After exceeding the Alarm Threshold Temperature, a sound alarm is generated and corresponding information shown on the display. The   Alarm Threshold is set in Setup Menu

While exceeding the Emergency Stop Temperature will stop the temperature stabilization process and then a sound and visual alarm will be generated..

2.6   Screen Saver

To avoid the risk of Display burning due to prolonged displaying static image, the Screensaver feature is implemented.

Screensaver starts after the pre-set time since the last key press or knob turn was made. Under this conditions the display goes into mode IV (section 1.5)

2.7   USB Stream

The LTC302 Temperature Controller is equipped in the USB interface compatible with FTDI Virtual Com Port driver. This allows to control the controller parameters and reading its data using a PC with dedicated application. However, some data stream could be also enabled in setup menu:

It sends periodically controller data in order: ΔT, T_{ACT}, V_{INT}, T_{SET}

Every frame begins with '@E' and ends with line feed char <LF>. Individual data are separated by commas.

E.g.   @E0.0012,20.501,-0.0134,20.500<LF>

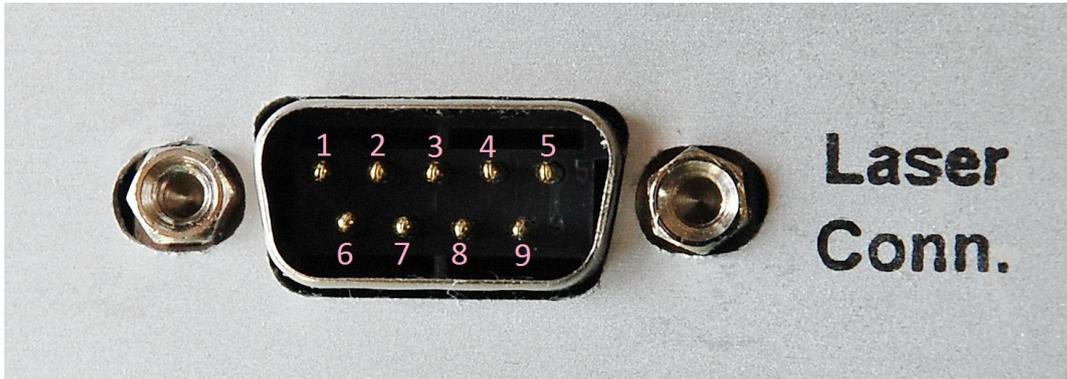ΔT = 0.0012

T_{ACT} = 20.501

V_{INT} = -0,0134

T_{SET} = 20.500

3.0 Laser output connector

1) LM35 SUPPLY (+15V)	6) OUT TEC (+)
2) Thermistor NTC	7) AD590 (-) / LM35 (GND)
3) Thermistor NTC	8) OUT TEC (-)
4) OUT TEC (+)	9) AD590 (+) / LM35 (out)
5) OUT TEC (-)	

4.0 Technical specification

Compatible Sensors:	NTC10kΩ, AD590, LM35
Temperature stability (24h):	± 0.001 ºC
Temperature stability (3h):	± 0.0003 ºC (NTC10kΩ)
Temperature coefficient :	~0.001 % / ºC
Temperature readout resolution:	0.001 ºC
Temperature readout error res.:	0.0001 ºC
Temperature setting range:	0 ÷ 50 ºC
Maximum output TEC current:	± 2.5 A
TEC output voltage	± 12 V
USB data rate	19200 bps
USB data conf.	8 bits, 1 stop
AC main voltage:	230 V ±10% / 50 to 60 Hz
Power Consumption:	40 W
Dimensions:	250 x 70 x 290 mm^3

Notes