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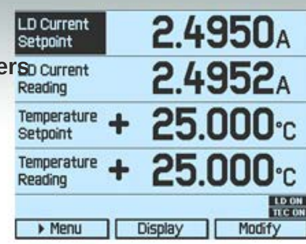
THORLABS

CAL-ITC4000 - June 9, 2021

Item # CAL-ITC4000 was discontinued on June 9, 2021. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

COMBINED LASER DIODE AND TEC CONTROLLERS

- ▶ Provides Laser Currents up to 1 A, 2 A, 5 A, or 20 A
- ▶ Supports TEC Currents up to ±8 A or ±15 A
- ▶ 17 V and 20 V Compliance Voltage Versions for Driving QCL and ICL Lasers
- ▶ Excellent 24 Hour Temperature Stability (0.002 °C)



The main measurement display shows readout values and device status information.

ITC4020

CAB4001

Hide Overview

OVERVIEW

Laser Diode Controller Features

- Operate with Anode- or Cathode-Grounded Laser Diodes and Photodiodes
- 17 V and 20 V Compliance Voltage Versions Capable of Driving High-Power QCLs
- Continuous Wave (CW) or Quasi-Continuous Wave (QCW) Operation
- Also Capable of Driving LEDs
- Internal Function Generator for Analog Modulation
- External Modulation Input
- Analog Monitor Output for the Laser Current
- Laser Diode Voltage Measurement
- Active Power Management for Efficient Operation
- **Compatible Optical Detectors**
  - Photodiodes
  - Thermopiles
  - Common Sensor Amplifiers
  - Power Meters with Voltage Output
- **Laser Diode Control Modes**
  - Constant Current (CC)
  - Constant Power (CP)
- **Enhanced Laser Diode Protection Features**
  - Adjustable Laser Current Limit
  - Adjustable Laser Power Limit
  - Laser Over Voltage Protection
  - Over Temperature Protection

TEC Controller Features

- Excellent Temperature Stability: 0.002 °C (24 hrs)
- Digital PID Control with Separate P, I, D Settings
- Auto PID Tuning Function
- Adjustable Temperature Sensor Offset
- **Compatible Temperature Sensors**
  - NTC Thermistors
  - Current Temperature Sensors
  - Voltage Temperature Sensors
  - Platinum RTD Temperature Sensors
- **TEC Control Modes**
  - Constant Temperature
  - Constant Current
- **Enhanced TEC Security Features**
  - Adjustable TEC Current Limit
  - Adjustable Temperature Limits
  - Temperature Window Protection
  - Fault Connection and Sensor Alarm

Thorlabs' Combined Laser Diode and TEC Controllers combine the functionality of a LDC4000 series current controller and a TED4015 temperature controller in a single device. They are designed to provide precise, stable current for laser diodes with maximum operating currents from 1 to 20 A (see the table to the lower right for

Item #[a]	ITC4001	ITC4002QCL	ITC4005	ITC4005QCL	ITC4020
Current Control Range	0 to 1 A	0 to 2 A	0 to 5 A	0 to 5 A	0 to 20 A
Compliance Voltage	11 V	17 V[b]	12 V	20 V[b]	11 V
Photocurrent Measurement Ranges	2 mA / 20 mA				
QCW[c] Mode Pulse Width Range	100 µs to 1 s				
QCW[d] Repetition Rate Range	1 ms to 5 s (0.2 to 1000 Hz)				

details) and excellent temperature stabilization to within 0.002 °C over a period of 24 hours. In addition to our standard versions which have a compliance voltage of 11 or 12 V, we offer two high-compliance-voltage drivers for our QCL and ICL lasers: the ITC4002QCL can provide up to 17 V at 2 A of current and the ITC4005QCL can provide up to 20 V at 5 A of current. For optimal noise performance, choose a controller that has maximum current and voltage ratings as close as possible to, but still higher than, the required voltage and current needed to operate your laser.

TEC Current Range[e]	-8 to +8 A	-15 to +15 A
TEC Compliance Voltage	>12 V	>15 V
TEC Output Power (Max)	>96 W	>225 W
Temperature Range (Max)	-150 to +150 °C[d]	
Supported Temperature Sensors	Thermistors (TH10K), Pt100 (TH100PT), Pt1000, AD590, AD592, LM335, LM235, LM135, LM35	

a. For complete specifications, see the Specs tab
b. The ITC4002QCL and ITC4005QCL have high compliance voltages designed to support our high-power QCLs. Information on the compatibility of this driver with our QCLs and ICLs can be found on the *Drivers* tab here.
c. Quasi-Continuous Wave
d. The applicable control range depends on the sensor parameters.
e. The TEC current limit is set to a low value before the unit is shipped, and needs to be increased by the user in order to enable thermal regulation.

The controllers are compatible with all laser diode and monitor diode pin configurations and feature a constant current (CC) or constant power (CP) mode. Most common temperature sensors can be used, and the ITC4000 can be adapted to different thermal loads via a digital PID controller. It offers an auto-tune PID function or separate control of the P, I, and D parameters. For more details about these features please see the *More Info* tab. The controllers are also compatible with our line of laser mounts, some of which also include TEC elements.

The ITC4000 devices are controlled via front panel keys and intuitive operation menus on a large and easy-to-read graphic LCD display (see the *Display* tab for sample screens). Additionally, these controllers can be controlled by a SCPI-compatible USB Interface. A higher setting and measurement resolution is offered via USB operation since the front panel resolution is limited by the resolution of the display. Various outputs and a digital I/O port offer many control and connectivity options. The built-in function generator allows analog modulation of the laser output out of the box.

These controllers offer many advanced features such as Quasi-Continuous Wave (QCW) operation mode, easy auto-tune PID, and diverse laser diode and TEC element protection (see the *More Info* tab). The controller design also provides silent and power-efficient operation. These features make the ITC4000 Series an ideal choice for safe and secure operation of medium- to high-power laser diodes and LEDs either in the lab or in production environments.

For driver software, as well as programming reference guides for Standard Commands for the Programmable Instruments (SCPI) standard, LabVIEW™, Visual C++, Visual C#, and Visual Basic, please see the *Software* tab.

Laser Diode Accessory Selection Guide					
Temperature Controlled Mounts	**Passive Mounts**	**Passive Mounts with Collimation Package**	**Strain Relief Cables**	**Diode Sockets**	**Other Controllers**
					

Hide More Info

MORE INFO

Laser Diode Operation Modes

The laser diodes can be driven in either **Constant Current (CC) mode**, where the laser current is held precisely at the level adjusted by the user, or **Constant Power (CP) mode**, where an optical power sensor is used to monitor the output power of the laser for active power control. The CC mode is preferable when the lowest noise and highest response speed are required, but this mode generally requires temperature stabilizing as well. In CP mode, feedback from the internal photodiode integrated into most laser diode packages, from an external photodiode, or other sensor is used to actively stabilize the laser's output power.

The ITC4000 Series offers two independent monitor inputs: one for photodiodes and one for thermopiles, either of which can be chosen for controlling the laser diode. The analog modulation via external input or the internal function generator allows modulation of the laser diode in CC and CP modes. A control output voltage proportional to the laser current is provided for monitoring purposes.

Pulsed Operation

Depending on the application, the ITC4000 Series of laser diode drivers can be operated in Continuous Wave (CW) or Quasi-CW (QCW) mode. To demonstrate the performance of these controllers, a screenshot of an oscilloscope measuring the output current of an ITC4020 in QCW mode is shown to the right. The ITC4020 produces sharp and accurate 100 µs pulses with a peak current of 20 A without any unwanted overshoots. The integrated pulse generator can be triggered internally with an adjustable repetition rate or externally via a BNC jack at the rear of the unit.

100 µs Pulses of 20 A

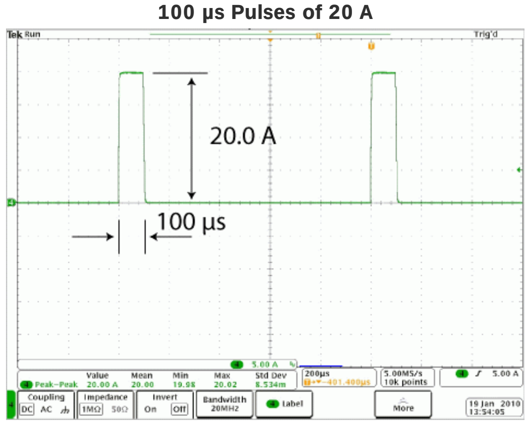


Figure: Oscilloscope screenshot of a typical short 100 µs Pulse of 20.0 A generated by the ITC4020 in QCW mode

Enhanced Protection Features for the Laser Diode

Current Limit: A precisely adjustable current limit ensures that the maximum laser current cannot be exceeded. Thorlabs has intentionally provided limited access to this feature to prevent accidental adjustment. An attempt to increase the laser drive current above the preset limit will result in a visible and short audible indicator. Even when utilizing the external modulation feature, the current limit setpoint cannot be exceeded.

Current Source: If the connection between the current source and laser diode is interrupted, the current source automatically switches off the current output. The open current circuit condition is indicated by the “OPEN” indicator on the controller and a short acoustic warning. The separate laser ON key switches the laser current on and off. When switched off, an electronic switch within the device short circuits the laser diode for added protection. After being switched on, a soft start ensures a slow increase of the laser current without voltage peaks. Even in the case of line failure, the laser current remains transient free. Voltage peaks on the AC line are effectively suppressed by electrical filters, shielding of the transformer, and careful grounding of the chassis.

TEC Controller

The ITC4000 Series contains a high-performance digital TEC controller for currents up to ±15 A. It offers an excellent temperature stability of 0.002 °C within 24 hrs together with the same enhanced safeguard and operation features similar to the TED4015. The digital PID controller can adapt to different thermal loads by individually adjustable parameters or by the auto PID function (for more details see the full presentation for the TED4015). The maximum control range of the temperature sensor input spans 100 Ω to 1 MΩ for thermistors and -55 to 150 °C for temperature sensing ICs or Platinum RTD sensors. The actual applicable temperature range is limited by the connected sensor and the thermal setup. For maximum TEC element protection, the ITC offers the same features as the TED4015. These protection features include an adjustable TEC output current limit and temperature sensor malfunction alerts.

The ITC4000 Series provides a monitoring signal proportional to the difference between actual and set temperature. An oscilloscope or an analog data acquisition card can be connected to the rear panel BNC connector to monitor the settling behavior with different thermal loads.

Hide Specs

SPECS

Laser Current Controller

Item #	ITC4001		ITC4002QCL		ITC4005		ITC4005QCL		ITC4020	
	Front Panel[a]	Remote Control[a]	Front Panel[a]	Remote Control[a]	Front Panel[a]	Remote Control[a]	Front Panel[a]	Remote Control[a]	Front Panel[a]	Remote Control[a]
Current Control (Constant Current Mode)										
Laser Diode Current Range	0 to 1 A		0 to 2 A		0 to 5 A		0 to 5 A		0 to 20 A	
Compliance Voltage	11 V		17 V		12 V		20 V		11 V	
Setting / Measurement Resolution	100 µA	16 µA	100 µA	32 µA	1 mA	80 µA	1 mA	80 µA	1 mA	320 µA
Accuracy	±(0.1% + 500 µA)		±(0.1% + 800 µA)		±(0.1% + 2 mA)		±(0.1% + 2 mA)		±(0.1% + 8 mA)	
Noise and Ripple (10 Hz to 10 MHz, rms, Typ., w/o Noise Reduction Filter)	<10 µA		<20 µA		<250 µA		<250 µA		<10 mA	
Noise and Ripple (10 Hz to 10 MHz, rms, Typ., w/ Noise Reduction Filter)	<3 µA		<5 µA		<50 µA		<50 µA		N/A	
Drift, 24 hours (0-10 Hz, typ., at Constant Ambient Temperature)	<100 µA		<150 µA		<300 µA		<300 µA		<1 mA	
Temperature Coefficient	≤50 ppm/°C									
Current Limit										
Setting Range	1 mA to 1 A		2 mA to 2 A		5 mA to 5 A		5 mA to 5 A		20 mA to 20 A	
Setting Resolution	100 µA	16 µA	100 µA	32 µA	1 mA	80 µA	1 mA	80 µA	1 mA	320 µA
Accuracy	±(0.12% + 800 µA)		±(0.12% + 1.6 mA)		±(0.12% + 3 mA)		±(0.12% + 3 mA)		±(0.12% + 12 mA)	
Power Monitor Input - Photodiode										
Photocurrent Measurement Ranges	0 to 2 mA / 0 to 20 mA									
Photocurrent Measurement Resolution (2 mA Range / 20 mA Range)	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA
Photocurrent Accuracy (2 mA Range / 20 mA Range)	±(0.08% +0.5 µA) / ±(0.08% +5 µA)									
Photodiode Reverse Bias Voltage	0 to 10 V									
Photodiode Input Impedance	~0 Ω (Virtual Ground)									
Power Monitor Input - Thermopile[b]										
Voltage Measurement Ranges	0 to 10 mV / 0 to 100 mV / 0 to 1V / 0 to 10V									
Voltage Measurement Resolution (for 10 mV, 100 mV, 1 V, 10 V Range)	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV
Voltage Measurement Accuracy (for 10 mV / 100 mV / 1V / 10 V Range)	±(0.1% + 10 µV) / ±(0.1% + 100 µV) / ±(0.1% + 1 mV) / ±(0.1% + 5 mV)									
Voltage Input Impedance	1 MΩ									
Laser Power Control (Constant Power Mode)										
Photocurrent Control Ranges[c]	0 to 2 mA / 0 to 20 mA									
Photocurrent Setting Resolution	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA	1 µA / 10 µA	32 nA / 320 nA
Thermopile Voltage Control Ranges[c]	1 µV to 10 mV / 10 µV to 100 mV / 100 µV to 1V / 1 mV to 10V									
Thermopile Voltage Setting Resolution	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV	1 µV 10 µV 100 µV 1 mV	0.16 µV 1.6 µV 16 µV 160 µV

Power Limit (Constant Power Mode)										
Photocurrent Limit Setting Ranges[c]	5 µA to 2 mA / 50 µA to 20 mA									
Photocurrent Limit Resolution (2 mA Range/ 20 mA Range)	1 µA / 10 µA	128 nA / 1.28 µA	1 µA / 10 µA	128 nA / 1.28 µA	1 µA / 10 µA	128 nA / 1.28 µA	1 µA / 10 µA	128 nA / 1.28 µA	1 µA / 10 µA	128 nA / 1.28 µA
Photocurrent Limit Accuracy	±20 µA / ±200 µA									
Thermopile Voltage Limit Setting Ranges[c]	1 µV to 10 mV / 10 µV to 100 mV / 100 µV to 1V / 1 mV to 10V									
Thermopile Voltage Limit Resolution	1 µV 10 µV 100 µV 1 mV	730 nV 7.3 µV 73 µV 730 µV	1 µV 10 µV 100 µV 1 mV	730 nV 7.3 µV 73 µV 730 µV	1 µV 10 µV 100 µV 1 mV	730 nV 7.3 µV 73 µV 730 µV	1 µV 10 µV 100 µV 1 mV	730 nV 7.3 µV 73 µV 730 µV	1 µV 10 µV 100 µV 1 mV	730 nV 7.3 µV 73 µV 730 µV
Thermopile Voltage Limit Accuracy	±10 µV / ±100 µV / ±1 mV / ±10 mV									
Item #	**ITC4001**		**ITC4002QCL**		**ITC4005**		**ITC4005QCL**		**ITC4020**	
	Front Panel[a]	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**
Laser Voltage Measurement										
Measurement Principle	4-Wire									
Measurement Resolution	1 mV	160 µV	1 mV	320 µV	1 mV	160 µV	1 mV	320 µV	1 mV	160 µV
Accuracy	±20 mV		±30 mV		±20 mV		±30 mV		±20 mV	
Laser Overvoltage Protection										
Setting Range	1 V to 11 V		1 V to 17 V		1 V to 12 V		1 V to 20 V		1 V to 11 V	
Resolution	1 mV									
Accuracy	±50 mV		±70 mV		±50 mV		±70 mV		±50 mV	
Laser Current Monitor Output										
Load Resistance	>10 kΩ									
Transmission Coefficient	10 V/A ±5%		5 V/A ± 5%		2 V/A ±5%		2 V/A ±5%		500 mV/A ±5%	
External Modulation Input										
Input Impedance	10 kΩ									
Small Signal 3dB Bandwidth, CC Mode w/o Noise Reduction Filter	DC to 150 kHz (2 Ω Load)		DC to 130 kHz (2 Ω Load)		DC to 100 kHz (1 Ω Load)		DC to 100 kHz (1 Ω Load) DC to 50 kHz (5 Ω Load)		DC to 50 kHz (0.2 Ω Load)	
Small Signal 3dB Bandwidth, CC Mode w/ Noise Reduction Filter	DC to 10 kHz (2 Ω Load)		DC to 10 kHz (2 Ω Load)		DC to 6 kHz (1 Ω Load)		DC to 6 kHz (1 Ω Load) DC to 5 kHz (5 Ω Load)		N/A	
Modulation Coefficient, CC Mode	100 mA/V ±5%		200 mA/V ± 5%		500 mA/V ±5%		500 mA/V ±5%		2A/V ±5%	
Modulation Coefficient, CP Mode, Current Sensor[c]	200 µA/V / 2 mA/V ±5%									
Modulation Coefficient, CP Mode, Voltage Sensor[c]	1 mV/V / 10 mV/V / 100 mV/V / 1V/V ±5%									
Internal Laser Modulation										
Waveforms	Sine, Square, Triangle									
Frequency Range	20 Hz to 150 kHz		20 to 130 kHz		20 Hz to 100 kHz		20 Hz to 100 kHz		20 Hz to 50 kHz	
Modulation Depth	0.1 to 100%									
QCW Mode										
Pulse Width Range	100 µs to 1 s									
Pulse Width Resolution	1 µs									
Repetition Rate Range	1 ms to 5 s (0.2 to 1000 Hz)									
Repetition Rate Resolution	10 µs									
Trigger										
Input	Rising Edge Triggered, Starts QCW Pulse with Internal Adjusted Width									
Input Level	TTL or 5 V CMOS									
Output	Active High, Tracks Pulse Width									
Output Level	TTL or 5 V CMOS									
Dead Time to Next Pulse	>10 µs									

a. Via front panel, the resolution is limited by the display. Via Remote Control, a higher resolution is offered.
b. The Thermopile Power Monitor Input can also be used for sensor amplifiers and power meters with voltage output.
c. Depending on the selected measurement range.

All technical data valid at 23 ± 5 °C and 45 ± 15% relative humidity. Subject to change without notice.

Temperature Control

Item #	**ITC4001**		**ITC4002QCL**		**ITC4005**		**ITC4005QCL**		**ITC4020**	
	Front Panel[a]	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**
TEC Current Control										

Control Range	-8 to +8 A		-15 to +15 A							
Compliance Voltage	>12 V		>15 V							
Maximum Output Power	>96 W		>225 W							
Resolution, CC Mode	1 mA	0.1 mA	1 mA	0.1 mA	1 mA	0.1 mA	1 mA	0.1 mA	1 mA	0.1 mA
Accuracy	±(0.2% + 20 mA)									
Noise and Ripple typ.	<10 mA rms									
TEC Current Limit										
Setting Range[b]	0.1 A to 8 A		0.1 A to 15 A							
Resolution	1 mA	0.1 mA	1 mA	0.1 mA	1 mA	0.1 mA	1 mA	0.1 mA	1 mA	0.1 mA
Accuracy	±(0.2% + 10 mA)									
NTC Thermistor Sensors										
Resistance Measurement Ranges	100 Ω to 100 kΩ / 1 kΩ to 1 MΩ									
Control Range Max[c]	-150 to +150 °C									
Temperature Resolution	0.001 °C									
Resolution (Resistance, 100 kΩ / 1 MΩ Range)	0.1 Ω / 1 Ω	0.03 Ω / 0.3 Ω	0.1 Ω / 1 Ω	0.03 Ω / 0.3 Ω	0.1 Ω / 1 Ω	0.03 Ω / 0.3 Ω	0.1 Ω / 1 Ω	0.03 Ω / 0.3 Ω	0.1 Ω / 1 Ω	0.03 Ω / 0.3 Ω
Accuracy (100 kΩ / 1 MΩ Range)	±(0.06% + 1 Ω / 5 Ω)									
Temperature Stability (24 Hours Typical)[c]	<0.002 °C									
Temperture Coefficient	<5 mK/°C									
IC Sensors										
Supported Current Temperature Sensors	AD590, AD592									
Supported Voltage Temperature Sensors	LM335, LM235, LM135, LM35									
Control Range with AD590	-55 to +150 °C									
Control Range with AD592	-25 to +105 °C									
Control Range with LM335	-40 to +100 °C									
Control Range with LM235	-40 to +125 °C									
Control Range with LM135	-55 to +150 °C									
Control Range with LM35	-55 to +150 °C									
Resolution	0.001 °C	0.0001 °C	0.001 °C	0.0001 °C	0.001 °C	0.0001 °C	0.001 °C	0.0001 °C	0.001 °C	0.0001 °C
Accuracy AD590 Current	± (0.04% + 0.08 µA)									
Accuracy LM335/LM35 Voltage	± (0.03% + 1.5 mV)									
Temperature Stability (24 hours)	<0.002 °C									
Temperature Coefficient	<5 mK/°C									
Item #	**ITC4001**				**ITC4005**		**ITC4005QCL**		**ITC4020**	
	Front Panel[a]	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**	**Front Panel[a]**	**Remote Control[a]**
Pt100/Pt1000 RTD Sensors										
Temperature Control Range	-55 to +150 °C									
Resolution	0.001 °C	0.0003 °C	0.001 °C	0.0003 °C	0.001 °C	0.0003 °C	0.001 °C	0.0003 °C	0.001 °C	0.0003 °C
Accuracy (4-Wire Measurement)	±0.3 °C									
Temperature Stability (24 Hours)	<0.005 °C									
Temperature Coefficient	<20 mK/°C									
Temperature Window Protection										
Setting Range T_{win}	0.01 to 100.0 °C									
Protection Reset Delay	0 to 600 s									
Window Protection Output	TTL or 5 V CMOS									
Temperature Control Output										
Load Resistance	>10 k Ω									
Transmission Coefficient	ΔT * 5V / T_{win} ±0.2 % (Temperature Deviation, Scaled to Temperature Window)									
TEC Voltage Measurement										
Measurement Principle	4-Wire/2-Wire									
Resolution	100 mV	40 mV	100 mV	40 mV	100 mV	40 mV	100 mV	40 mV	100 mV	40 mV
Accuracy (with 4-Wire Measurement)	±50 mV									

a. Via front panel, the resolution is limited by the display. Via Remote Control, a higher resolution is offered.
b. The TEC current limit is set to a low value before the unit is shipped, and needs to be increased by the user in order to enable thermal regulation.
c. Control range and thermal stability depend on thermistor parameters.

All technical data valid at 23 ± 5 °C and 45 ± 15% relative humidity. Subject to change without notice.

General Specifications

Item #	ITC4001	ITC4002QCL	ITC4005	ITC4005QCL	ITC4020

Digital I/O Port					
Number of I/O lines	4 (Separately Configurable)				
Input Level	TTL or CMOS, Voltage Tolerant up to 24 V				
Output Level (Source Operation)	TTL or 5 V CMOS, 2 mA Max				
Output Level (Sink Operation)	Open Collector, up to 24 V, 400 mA Max				
Interface					
USB 2.0	According to USBTMC/USBTMC-USB488 Specification Rev. 1.0				
Protocol	SCPI Compliant Command Set				
Drivers	VISA VXIpnp™, MS Visual Studio™, MS Visual Studio.net™, NI LabVIEW™, NI LabWindows/CVI™				
General Data					
Safety Features	Interlock, Inhibit, Keylock Switch, Laser Current Limit, Laser Power Limit, Soft Start, Short Circuit when Laser Off, Adjustable Laser Overvoltage Protection, Over Temperature Protection Temperature Window Protection				
Display	LCD 320 x 240 Pixel				
Connector for Laser, Photodiode, Interlock, and Laser On Signal	13W3 Mixed D-Sub Jack (female)				
Connector for Sensor, TE Cooler, TEC On Signal	17W2 Mixed D-Sub Jack (female)				
Connectors for Control Input / Output	BNC				
Connector for Digitial I/O	Mini DIN 6				
Connector for USB-Interface	USB Type B				
Chassis Ground Connector	4 mm Banana Jack				
Line Voltage / Frequency	100 to 120 V and 200 to 240 V ±10%, 50 to 60 Hz				
Maximum Power Consumption	300 VA	600 VA	650 VA	880 VA	900 VA
Mains Supply Overvoltage	Category II (Cat II)				
Operating Temperature	0 to 40 °C				
Storage Temperature	- 40 to +70 °C				
Relative Humidity	Max. 80% Up to 31 °C, Decreasing to 50% at 40 °C				
Pollution Degree (Indoor Use Only)	2				
Operation Altitude	<2000 m				
Warm-up Time for Rated Accuracy	30 min				
Weight	6.4 kg				
Dimensions w/o Operating Elements (W x H x D)	263 mm x 122 mm x 307 mm (10.4" x 4.8" x 12.1")				
Dimensions /w Operating Elements (W x H x D)	263 mm x 122 mm x 345 mm (10.4" x 4.8" x 13.6")				

All technical data valid at 23 ± 5 °C and 45 ± 15% relative humidity. Subject to change without notice.

Hide Front & Back Panel

FRONT & BACK PANEL

ITC4000 Series Front Panel

Click to Enlarge

Callout	Connection	Callout	Connection
1	Key Switch	5	Escape Key
2	Supply Power Switch	6	TEC Status Indicator
3	LC Display	7	LD Status Indicator
4	Softkeys for Menu Navigation	8	Adjustment Knob

ITC4000 Series Back Panel

Click to Enlarge

Callout	Connection	Callout	Connection
1	TTL Input "Laser Enable In" 5 V Max	9	LD Output and Optical Sensor Input "Laser Output"
2	TTL Input "QCW Pulse In" 5 V Max	10	Power Connector and Fuse Holder "Line In"
3	TTL Output "Trigger Out" 0 - 5 V	11	USB Connector
4	Optical Sensor Input "Opt Sensor In" 0 to 10 V Max	12	4 mm Banana Jack for Chassis Ground
5	Modulation input "Modulation In" -10 to 10 V	13	MiniDin-6 Jack "Digital I/O"
6	Laser Current Monitor "Analog CTL Out" 0 - 10 V	14	Actual Temperature Deviation Output "Deviation Out" -5 to 5 V
7	Serial Number of the Unit	15	TTL Temperature Monitor Output "Temp OK Out" 5 V

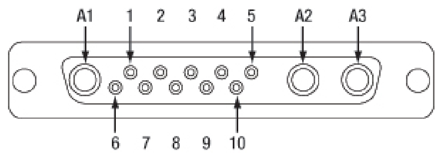
8	Cooling Fan	16	TEC Element Output and Temperature Sensor Input "TEC Output"

Hide Pin Diagrams

PIN DIAGRAMS

LD Output

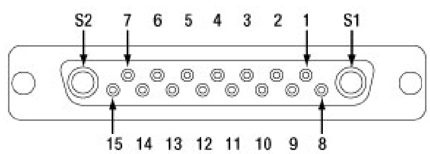
13W3 Mixed D-Sub Female



Pin	Connection	Pin	Connection
1	(Thermo) Voltage Sensor Input (+)	7	Photo Current Sensor Input (+)
2	(Thermo) Voltage Sensor Ground (-)	8	Photo Current Sensor Ground (-)
3	Not Connected	9	Not Connected
4	Laser Diode Anode (+)	10	Laser Diode Cathode (-)
5	Output for Interlock and Status Indicator "LASER ON/OFF" (+)	A1	Laser Diode Ground
6	Ground Pin for Interlock and Status Indicator "LASER ON/OFF" (-)	A2	Laser Diode Cathode (with Polarity AG) (-)
		A3	Laser Diode Anode (with Polarity CG) (+)

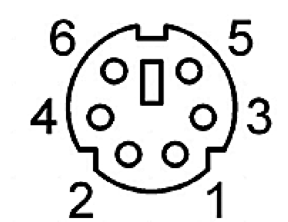
TEC Output

17W2 Mixed D-Sub Female



Pin	Connection	Pin	Connection
1	Interlock, TEC ON LED (+)	10	PT100/1000 (-), AD590/592 (-), LM35 Out, LM135/235/335 (+)
2	Voltage Measurement TEC Element (+)	11	PT100/1000 (+), AD590/592 (+), LM35/135/235/335 (+)
3	Thermistor (-), PT100/1000 (-), Analog Ground	12	Analog Ground, LM35/135/235/335 (-)
4	Thermistor (+), PT100/1000 (+)	13	Not Connected
5	Analog Ground, LM35/135/235/335 (-)	14	I/O 1-wire (Currently Not Used)
6	Digital Ground for I/O 1-wire	15	Ground for 12 V Output and Interlock, TEC ON LED (-)
7	12 V Output (for External Fan, max. current = 500 mA)	S1	TEC Element (+) (Peltier Element)
8	Not Connected	S2	TEC Element (-) (Peltier Element)
9	Voltage Measurement TEC Element (-)		

Digital I/O Ports



Pin	Connection
1	I/O 1
2	I/O 2
3	I/O 3
4	I/O 4
5	GND
6	I/O Supply Voltage (+12 V from Internal or Higher External Voltage up to +24 V)

LD Enable In

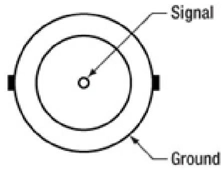
BNC Female

QCW Pulse In

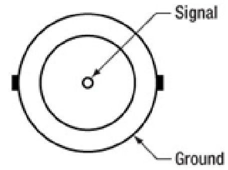
BNC Female

Trigger Out

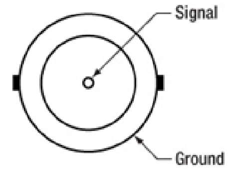
BNC Female



Laser Enable Input (High to Enable Laser ON), TTL 5 V Max

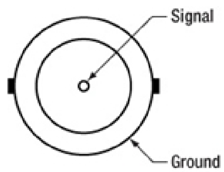


Input for External Trigger Signal, TTL 5 V Max



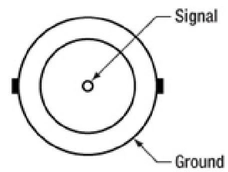
QCW Pulse Tracking Output, TTL 5 V

OPT Sensor In
BNC Female



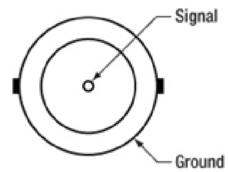
Input for Optical Sensor, 0 to +10 V Max

Modulation In
BNC Female



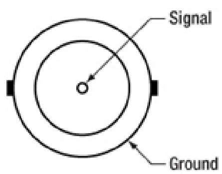
Input for External Modulation Signal, -10 to +10 V Max

Analog CTL Out
BNC Female



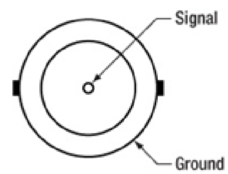
Output for Laser Current Monitoring, 0 to +10 V

Deviation Out
BNC Female



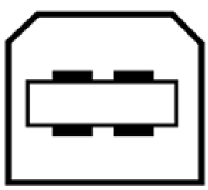
Actual Temperature Deviation Output, -5 to +5 V

Temp OK Out
BNC Female



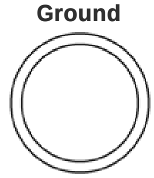
Temperature OK Output (High if Inside Temperature Window), TTL 5 V

Computer Connection
USB Type B



USB Type B to Type A Cable Included

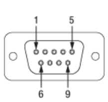
Ground



4 mm Banana Jack for Chassis Ground

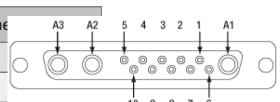
CAB4005 Laser Diode Cable

This cable contains a DB-9 male connector on one side and a 13W3 male connector on the other side. Both views shown below are looking into the connector.



DB-9 Male Connector

DB-9 Conne[illegible]	
Pin	[illegible]
1	[illegible]
2	Gray and Pink
3	Gray / Black[a]
4	Red and Blue
5	Brown
6	Blue
7	Yellow / Purple[a]
8	Green / Pink[a]
9	Red



13W3 Male Connector

13W3 Connector Colors			
Pin	Color	Pin	Color
1	No Connection	9	No Connection
2	No Connection	10	Blue
3	No Connection	A1	Gray / Black[a]
4	Red		
5	White	A2	Yellow / Purple[a]
6	Brown		
7	Red and Blue	A3	Green / Pink[a]
8	Green and Pink		

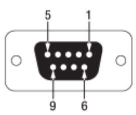
a. Uses Two Wires

a. Uses Two Wires

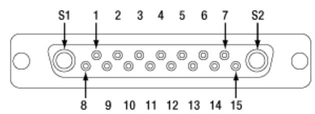
Pin Matching		
DB-9 Pin	**13W3 Pin**	**Description of ITC Functionality**
1	5	Output for Interlock and Status Indicator "LASER ON/OFF" (+)
2	8	Photo Current Sensor Ground (-)
3	A1	Laser Diode Ground
4	7	Photo Current Sensor Input (+)
5	6	Ground Pin for Interlock and Status Indicator "LASER ON/OFF" (-)
6	10	Laser Diode Cathode (-)
7	A2	Laser Diode Cathode (with Polarity AG) (-)
8	A3	Laser Diode Anode (with Polarity CG) (+)
9	4	Laser Diode Anode (+)
Shield	Shield	-

CAB4000 TEC Element Cable

This cable contains a DB-9 female connector on one side and a 17W2 male connector on the other side. Both views shown below are looking into the connector.



DB-9 Female Connector



17W2 Male Connector

DB-9 Connector Colors	
Pin	**Color**
1	White
2	Pink and Gray
3	Red and Blue
4	Pink / Red / Purple (3 Wires)
5	Black / Gray / Blue (3 Wires)
6	No Connection
7	Yellow
8	Brown
9	Green

17W2 Connector Colors			
Pin	**Color**	**Pin**	**Color**
1	White	11	Green
2	Red	12	Brown
3	Red and Blue	13	No Connection
4	Pink and Gray	14	No Connection
5	Brown	15	White
6	No Connection	S1	Purple / Pink (2 Wires)
7	No Connection		
8	No Connection	S2	Black / Gray (2 Wires)
9	Blue		
10	Yellow		

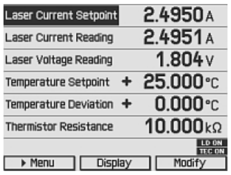
Pin Matching		
DB-9 Pin	**17W2 Pin(s)**	**Description of ITC Functionality**
1	1	Interlock, TEC ON LED (+)
	15	Ground for 12 V Output and Interlock, TEC ON LED (-)
2	4	Thermistor (+), PT100/1000 (+)
3	3	Thermistor (-), PT100/1000 (-), Analog Ground
4	2	Voltage Measurement TEC Element (+)
	S1	TEC Element (+) (Peltier Element)
5	9	Voltage Measurement TEC Element (-)
	S2	TEC Element (-) (Peltier Element)
6	No Connection	-
7	10	PT100/1000 (-), AD590/592 (-), LM35 Out, LM135/235/335 (+)
8	5	Analog Ground, LM35/135/235/335 (-)
	12	Analog Ground, LM35/135/235/335 (-)
9	11	PT100/1000 (+), AD590/592 (+), LM35/135/235/335 (+)
Shield	Shield	-

Hide Display

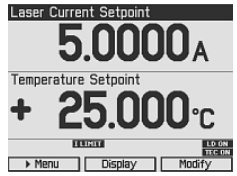
DISPLAY

Sample Screens of the ITC4000 Series

Measurement Screen 1		Measurement Screen 2	
	The measurement screen offers easy readout of measurement		

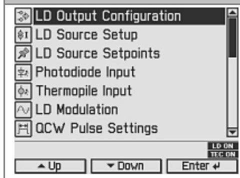


values and device status information. It also allows the major instrument setpoints to be adjusted. You can freely select two, four, or six values to be displayed with optimized character size.



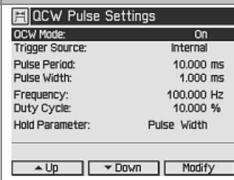
Here the measurement screen is configured to 2 values. The character size is enlarged as much as possible for easier reading.

Menu Screen



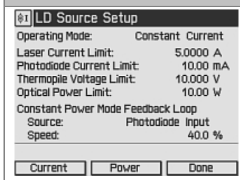
The menu screen allows various operation modes and options to be selected.

QCW Settings Screen



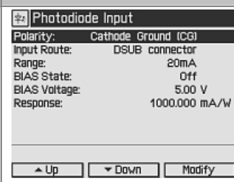
This is the input screen for the Quasi-Continuous Wave (QCW) pulse mode settings, e.g. trigger source and pulse parameters.

Laser Diode Setup Screen



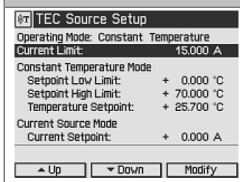
The laser diode setup screen allows the user to enter essential laser control parameters: constant current or constant power mode, limits for laser current and laser power, speed and source of the constant power feedback loop.

Photodiode Input Screen



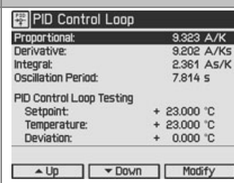
All parameters concerning the photodiode sensor are entered via the Photodiode Input Screen.

Temperature Controller Screen



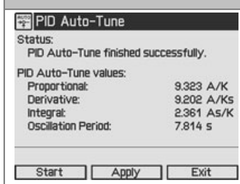
All parameters for the temperature controller are entered via the Temperature Controller Screen: Operation Mode, Current Limit, Current Control Mode Settings, Temperature Sensor Settings.

Temperature Mode Settings Screen



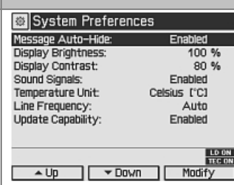
For manual optimization, the temperature PID control loop settings can be entered here. Temperature setpoint and actual reading are accessible for convenient testing.

PID Auto-Tune Screen



The PID auto-tune function is started via this screen. The ITC4000 automatically selects the optimal PID parameters for the current thermal setup.

Preferences Screen



The preferences screen offers access to the device preferences, e.g. display and signal settings.

Hide Software

SOFTWARE

Software for Laser Diode Controllers

The download button below links to VISA VXI pnp™, MS Visual Studio™, MS Visual Studio.net™, LabVIEW™, and LabWindows/CVI™ drivers, firmware, utilities, and support documentation for Thorlabs' ITC4000 Series laser controllers, LDC4000 Series laser controllers, CLD1000 Series compact laser diode controllers, and TED4000 Series TEC controllers.

The software download page also offers programming reference notes for interfacing with compatible controllers using SCPI, LabVIEW, Visual C++, Visual C#, and Visual Basic. Please see the *Programming Reference* tab on the software download page for more information and download links.

Driver Software

Version 3.1.0 (April 11, 2014)

Programming Reference

Version 3.3 (April 8, 2015) - SCPI Commands
Version 1.0 (June 16, 2015) - LabVIEW, Visual C++, Visual C#, Visual Basic

Software

The software packages support LabVIEW 8.5 and higher. If you are using an earlier version of LabVIEW, please contact Tech Support for assistance.

Hide Shipping List

SHIPPING LIST

Item #	ITC4001	ITC4002QCL	ITC4005	ITC4005QCL	ITC4020
Components					

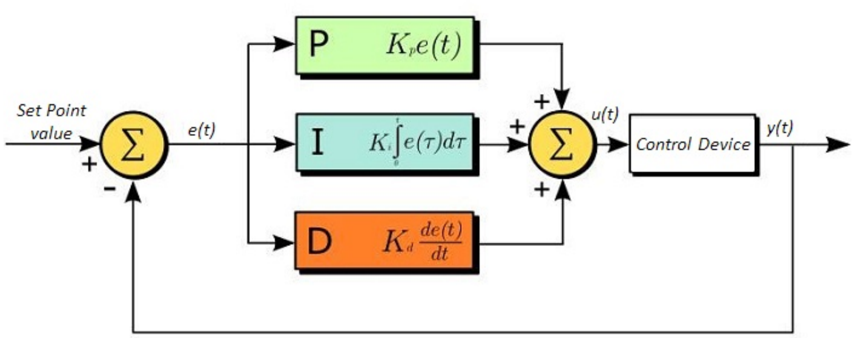
Benchtop Laser Diode/TEC Controller, 1 A / 96 W	✓	-	-	-	-
Benchtop Laser Diode/TEC Controller, 2 A / 225 W with 17 V Compliance for QCLs	-	✓		-	-
Benchtop Laser Diode/TEC Controller, 5 A / 225 W	-	-	✓	-	-
Benchtop Laser Diode/TEC Controller, 5 A / 225 W with 20 V Compliance for QCLs	-	-	-	✓	-
Benchtop Laser Diode/TEC Controller, 20 A / 225 W	-	-	-	-	✓
Cable TED4000/ITC4000 to Laser Mount, 5 A, 17W2, D-Sub-9 (CAB4000)	✓	✓	✓	✓	-
Cable TED4000/ITC4000 to Laser Mount, 20 A, 17W2, 17W2 (CAB4001)	-	-	-	-	✓
Cable LDC4000/ITC4000 to Laser Mount, 5 A, 13W3, D-Sub-9 (CAB4005)	✓	✓	✓	✓	-
Cable LDC4000/ITC4000 to Laser Mount, 20 A, 13W3, 13W3 (CAB4006)	-	-	-	-	✓
Mixed D-Sub Connector, 17W2, Male & Female with 2 High-Current Contacts Each, 20 A (CON4001)	✓	✓	✓	✓	✓
Mixed D-Sub Connector, 13W3, Male & Female with 3 High-Current Contacts Each, 20 A (CON4005)	✓	✓	✓	✓	✓
USB Cable A-B, 2 m	✓	✓	✓	✓	✓
4000 Series Instrumentation CD	✓	✓	✓	✓	✓
ITC4000 Series Printed Operation Manual	✓	✓	✓	✓	✓
Certificate of Calibration	✓	✓	✓	✓	✓

Hide PID Tutorial

PID TUTORIAL

PID Basics

The PID circuit is often utilized as a control loop feedback controller and is very commonly used for many forms of servo circuits. The letters making up the acronym PID correspond to Proportional (P), Integral (I), and Derivative (D), which represents the three control settings of a PID circuit. The purpose of any servo circuit is to hold the system at a predetermined value (set point) for long periods of time. The PID circuit actively controls the system so as to hold it at the set point by generating an error signal that is essentially the difference between the set point and the current value. The three controls relate to the time-dependent error signal; at its simplest, this can be thought of as follows: Proportional is dependent upon the present error, Integral is dependent upon the accumulation of past error, and Derivative is the prediction of future error. The results of each of the controls are then fed into a weighted sum, which then adjusts the output of the circuit, u(t). This output is fed into a control device, its value is fed back into the circuit, and the process is allowed to actively stabilize the circuit's output to reach and hold at the set point value. The block diagram below illustrates very simply the action of a PID circuit. One or more of the controls can be utilized in any servo circuit depending on system demand and requirement (i.e., P, I, PI, PD, or PID).



Through proper setting of the controls in a PID circuit, relatively quick response with minimal overshoot (passing the set point value) and ringing (oscillation about the set point value) can be achieved. Let's take as an example a temperature servo, such as that for temperature stabilization of a laser diode. The PID circuit will ultimately servo the current to a Thermo Electric Cooler (TEC) (often times through control of the gate voltage on an FET). Under this example, the current is referred to as the Manipulated Variable (MV). A thermistor is used to monitor the temperature of the laser diode, and the voltage over the thermistor is used as the Process Variable (PV). The Set Point (SP) voltage is set to correspond to the desired temperature. The error signal, e(t), is then just the difference between the SP and PV. A PID controller will generate the error signal and then change the MV to reach the desired result. If, for instance, e(t) states that the laser diode is too hot, the circuit will allow more current to flow through the TEC (proportional control). Since proportional control is proportional to e(t), it may not cool the laser diode quickly enough. In that event, the circuit will further increase the amount of current through the TEC (integral control) by looking at the previous errors and adjusting the output in order to reach the desired value. As the SP is reached [e(t) approaches zero], the circuit will decrease the current through the TEC in anticipation of reaching the SP (derivative control).

Please note that a PID circuit will not guarantee optimal control. Improper setting of the PID controls can cause the circuit to oscillate significantly and lead to instability in control. It is up to the user to properly adjust the PID gains to ensure proper performance.

PID Theory

The output of the PID control circuit, u(t), is given as

$$u(t) = MV(t) = K_p e(t) + K_i \int_0^t e(\tau) d\tau + K_d \frac{d}{dt} e(t)$$

where

K_p= Proportional Gain

K_i = Integral Gain

K_d = Derivative Gain

e(t) = SP - PV(t)

From here we can define the control units through their mathematical definition and discuss each in a little more detail. Proportional control is proportional to the error signal; as such, it is a direct response to the error signal generated by the circuit:

$$P = K_p e(t)$$

Larger proportional gain results is larger changes in response to the error, and thus affects the speed at which the controller can respond to changes in the system. While a high proportional gain can cause a circuit to respond swiftly, too high a value can cause oscillations about the SP value. Too low a value and the circuit cannot efficiently respond to changes in the system.

Integral control goes a step further than proportional gain, as it is proportional to not just the magnitude of the error signal but also the duration of the error.

$$I = K_i \int_0^t e(\tau) d\tau$$

Integral control is highly effective at increasing the response time of a circuit along with eliminating the steady-state error associated with purely proportional control. In essence integral control sums over the previous error, which was not corrected, and then multiplies that error by K_i to produce the integral response. Thus, for even small sustained error, a large aggregated integral response can be realized. However, due to the fast response of integral control, high gain values can cause significant overshoot of the SP value and lead to oscillation and instability. Too low and the circuit will be significantly slower in responding to changes in the system.

Derivative control attempts to reduce the overshoot and ringing potential from proportional and integral control. It determines how quickly the circuit is changing over time (by looking at the derivative of the error signal) and multiplies it by K_d to produce the derivative response.

$$D = K_d \frac{d}{dt} e(t)$$

Unlike proportional and integral control, derivative control will slow the response of the circuit. In doing so, it is able to partially compensate for the overshoot as well as damp out any oscillations caused by integral and proportional control. High gain values cause the circuit to respond very slowly and can leave one susceptible to noise and high frequency oscillation (as the circuit becomes too slow to respond quickly). Too low and the circuit is prone to overshooting the SP value. However, in some cases overshooting the SP value by any significant amount must be avoided and thus a higher derivative gain (along with lower proportional gain) can be used. The chart below explains the effects of increasing the gain of any one of the parameters independently.

Parameter Increased	Rise Time	Overshoot	Settling Time	Steady-State Error	Stability
K_p	Decrease	Increase	Small Change	Decrease	Degrade
K_i	Decrease	Increase	Increase	Decrease Significantly	Degrade
K_d	Minor Decrease	Minor Decrease	Minor Decrease	No Effect	Improve (for small K_d)

Tuning

In general the gains of P, I, and D will need to be adjusted by the user in order to best servo the system. While there is not a static set of rules for what the values should be for any specific system, following the general procedures should help in tuning a circuit to match one's system and environment. In general a PID circuit will typically overshoot the SP value slightly and then quickly damp out to reach the SP value.

Manual tuning of the gain settings is the simplest method for setting the PID controls. However, this procedure is done actively (the PID controller turned on and properly attached to the system) and requires some amount of experience to fully integrate. To tune your PID controller manually, first the integral and derivative gains are set to zero. Increase the proportional gain until you observe oscillation in the output. Your proportional gain should then be set to roughly half this value. After the proportional gain is set, increase the integral gain until any offset is corrected for on a time scale appropriate for your system. If you increase this gain too much, you will observe significant overshoot of the SP value and instability in the circuit. Once the integral gain is set, the derivative gain can then be increased. Derivative gain will reduce overshoot and damp the system quickly to the SP value. If you increase the derivative gain too much, you will see large overshoot (due to the circuit being too slow to respond). By playing with the gain settings, you can maximize the performance of your PID circuit, resulting in a circuit that quickly responds to changes in the system and effectively damps out oscillation about the SP value.

While manual tuning can be very effective at setting a PID circuit for your specific system, it does require some amount of experience and understanding of PID circuits and response. The Ziegler-Nichols method for PID tuning offers a bit more structured guide to setting PID values. Again, you'll want to set the integral and derivative gain to zero. Increase the proportional gain until the circuit starts to oscillate. We will call this gain level K_u. The oscillation will have a period of P_u. Gains are for various control circuits are then given below in the chart.

Control Type	K_p	K_i	K_d
P	0.50 K_u	-	-
PI	0.45 K_u	1.2 K_p/P_u	-
PID	0.60 K_u	2 K_p/P_u	$K_pP_u/8$

Hide Selection Guide

SELECTION GUIDE

Laser Diode Controller Selection Guide

The tables below are designed to give a quick overview of the key specifications for our laser diode controllers and dual diode/temperature controllers. For more details and specifications, or to order a specific item, click on the appropriate item number below.

Current Controllers						
Item #	Drive Current	Compliance Voltage	Constant Current	Constant Power	Modulation	Package
LDC200CV	20 mA	6 V	✓	✓	External	Benchtop
VLDC002	25 mA	5 V		-	Int/Ext	OEM

			✓			
LDC201CU	100 mA	5 V	✓	✓	External	Benchtop
LD2000R	100 mA	3.5 V	-	✓	External	OEM
EK2000	100 mA	3.5 V	-	✓	External	OEM
LDC202C	200 mA	10 V	✓	✓	External	Benchtop
KLD101	230 mA	≤10 V	✓	✓	External	K-Cube™
IP250-BV	250 mA	8 V[a]	✓	✓	External	OEM
LD1100	250 mA	6.5 V[a]	-	✓	--	OEM
LD1101	250 mA	6.5 V[a]	-	✓	--	OEM
EK1101	250 mA	6.5 V[a]	-	✓	--	OEM
EK1102	250 mA	6.5 V[a]	-	✓	--	OEM
LD1255R	250 mA	3.3 V	✓	-	External	OEM
LDC205C	500 mA	10 V	✓	✓	External	Benchtop
IP500	500 mA	3 V	✓	✓	External	OEM
LDC210C	1 A	10 V	✓	✓	External	Benchtop
LDC220C	2 A	4 V	✓	✓	External	Benchtop
LD3000R	2.5 A	--	✓	-	External	OEM
LDC240C	4 A	5 V	✓	✓	External	Benchtop
LDC4005	5 A	12 V	✓	✓	Int/Ext	Benchtop
LDC4020	20 A	11 V	✓	✓	Int/Ext	Benchtop

a. When using a 12 V power supply.

Dual Temperature and Current Controllers							
Item #	**Drive Current**	**Compliance Voltage**	**TEC Power (Max)**	**Constant Current**	**Constant Power**	**Modulation**	**Package**
VITC002	25 mA	5 V	>2 W	✓	-	Int/Ext	OEM
ITC102	200 mA	>4 V	12 W	✓	✓	Ext	OEM
ITC110	1 A	>4 V	12 W	✓	✓	Ext	OEM
ITC4001	1 A	11 V	>96 W	✓	✓	Int/Ext	Benchtop
CLD1010LP[a]	1.0 A	>8 V	>14.1 W	✓	✓	Ext	Benchtop
CLD1011LP[b]	1.0 A	>8 V	>14.1 W	✓	✓	Ext	Benchtop
CLD1015[c]	1.5 A	>4 V	>14.1 W	✓	✓	Ext	Benchtop
ITC4002QCL[d]	2 A	17 V	>225 W	✓	✓	Int/Ext	Benchtop
ITC133	3 A	>4 V	18 W	✓	✓	Ext	OEM
ITC4005	5 A	12 V	>225 W	✓	✓	Int/Ext	Benchtop
ITC4005QCL[d]	5 A	20 V	>225 W	✓	✓	Int/Ext	Benchtop
ITC4020	20 A	11 V	>225 W	✓	✓	Int/Ext	Benchtop

a. Combined controller and mount for pigtailed laser diodes in TO can packages with A, D, E, or G pin codes only.
b. Combined controller and mount for pigtailed laser diodes in TO can packages with B, C, or H pin codes only.
c. Combined controller and mount for laser diodes in butterfly packages only.
d. Enhanced compliance voltage for QCL operation.

We also offer a variety of OEM and rack-mounted laser diode current & temperature controllers (OEM Modules, PRO8 Current Control Rack Modules, and PRO8 Current and Temperature Control Rack Modules).

Hide Combined Laser Diode and TEC Benchtop Controllers

Combined Laser Diode and TEC Benchtop Controllers

Part Number	Description	Price	Availability
ITC4001	Benchtop Laser Diode/TEC Controller, 1 A / 96 W	$3,441.14	Today
ITC4002QCL	Benchtop Laser Diode/TEC Controller for QCLs, 2 A LD / 225 W TEC, 17 V	$4,370.67	Today
ITC4005	Benchtop Laser Diode/TEC Controller, 5 A / 225 W	$3,961.64	Today
ITC4005QCL	Benchtop Laser Diode/TEC Controller for QCLs, 5 A LD / 225 W TEC, 20 V	$5,289.39	5-8 Days
ITC4020	Benchtop Laser Diode/TEC Controller, 20 A / 225 W	$4,548.14	Today

Hide Laser Diode Connector Cables

Laser Diode Connector Cables

Item #	**CAB4005**	**CAB4006**	**CON4005**
Click Image to Enlarge			

These cables connect our ITC4000 series dual current / temperature controllers or our LDC4000 series current controllers to laser diodes. We also provide loose 13W3 connectors for customers who

			
Description	Standard Laser Diode Cable	High Current Laser Diode Cable	13W3 Male and Female Connector Kit (One Each)
Max Current	5 A	20 A	20 A
Connector Type	13W3 Male to DB-9 Male	13W3 Male to 13W3 Male	Loose 13W3 Connectors, Male and Female

wish to make their own cables. For the pinout of the CAB4005 and CAB4006 cables, please see the *Pin Diagrams* tab.

Please note that the CAB4005 cable is included with the purchase of the ITC4001, ITC4002QCL, ITC4005, and ITC4005QCL benchtop controllers. The ITC4020 is shipped with the CAB4006 cable. A CON4005 connector kit is included with all of these benchtop controllers (see the *Shipping List* tab for details).

Part Number	Description	Price	Availability
CAB4005	**Connection Cable for LDC4000/ITC4000, 13W3 to D-Sub-9, 5 A**	**$139.60**	**Today**
CAB4006	**Connection Cable for LDC4000/ITC4000, 13W3 to 13W3, 20 A**	**$142.84**	**Today**
CON4005	**Connector Kit, 13W3 Male & Female, 20 A**	**$16.02**	**5-8 Days**

Hide TEC Element Connector Cables

TEC Element Connector Cables

Item #	**CAB4000**	**CAB4001**	**CON4001**
Click Image to Enlarge			
Description	Standard TEC Element Cable	High Current TEC Element Cable	17W2 Male and Female Connector Kit (One Each)
Max Current	5 A	20 A	20 A
Connector Type	17W2 Male to DB-9 Female	17W2 Male to 17W2 Male	Loose 17W2 Connectors, Male and Female

These cables connect our ITC4000 series dual current / temperature controllers or our TED4015 temperature controller to thermoelectric cooling elements. We also provide loose 17W2 connectors for customers who wish to make their own cables. For the pinout of the CAB4000 and CAB4001 cables, please see the *Pin Diagrams* tab.

Please note that the CAB4000 cable is included with the purchase of the ITC4001, ITC4002QCL, ITC4005, and ITC4005QCL benchtop controllers. The ITC4020 is shipped with the CAB4001. The CON4001 connector kit is included with all of the controllers (see the *Shipping List* tab for specific details).

Part Number	Description	Price	Availability
CAB4000	**Connection Cable for TED4000/ITC4000, 17W2 to D-Sub-9, 5 A**	**$127.69**	**Today**
CAB4001	**Connection Cable for TED4000/ITC4000, 17W2 to 17W2, 20 A**	**$188.28**	**Today**
CON4001	**Connector Kit, 17W2 Male & Female, 20 A**	**$24.35**	**5-8 Days**

Hide ITC4000 Series Calibration Service

ITC4000 Series Calibration Service

Thorlabs offers Calibration Services for the ITC4000 LD Current/TEC Benchtop Controller Series. To ensure accurate measurements, we recommend recalibrating the devices every second year.

Please Note:
To ensure your item being returned for calibration is routed appropriately once it arrives at our facility, please do not ship it prior to being provided an RMA Number and return instructions by a member of our team.

Part Number	Description	Price	Availability
CAL-ITC4000	**Recalibration Service for ITC4000**	**$390.41**	**Lead Time**