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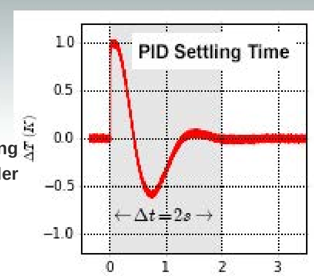
CAL-TED4000 - June 9, 2021

Item # CAL-TED4000 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.

225 W TEC CONTROLLER

- ▶ High TEC Power: 225 W (±15 A)
- ▶ Digital PID Controller
- ▶ Auto PID Parameter Setting
- ▶ USB Interface (SCPI)

Fast Temperature Settling by PID Controller



TED4015

CAB4001

Different Connection Cables Available as Accessory

Hide Overview

OVERVIEW

Features

- **Excellent Temperature Stability:** 0.002 °C (24 hrs)
- Digital PID Control with Separate P, I, and D Settings
- Automatic PID Setting Function
- Temperature Display in °C, °F, K
- Adjustable Temperature Sensor Offset
- Active Power Management for Efficient Power Use
- **Compatible Sensors:**
  - NTC Thermistors
  - Current Temperature Sensors
  - Voltage Temperature Sensors
  - Platinum RTD Temperature Sensors
- **Control Modes:**
  - Constant Temperature
  - Constant Current
- **Enhanced Security Features:**
  - Adjustable TEC Current Limit
  - Adjustable Temperature Limits
  - Temperature Window Protection
  - Sensor Fault Protection
- **Interface and Drivers:**
  - USB Interface (SCPI Compliant)
  - VXIpnp/VISA Drivers for Common Programming Environments like LabWindows/CVI™, LabVIEW™, and MS Visual Studio™

Item #	TED4015
Temperature Stability	0.002 °C (24 hrs)
TEC Output	±15 A
Compliance Voltage	15 V
Temperature Control Range	-55 to 150 °C
Resistance Measurement Range (2 Ranges)	100 Ω to 100 kΩ or 1kΩ to 1 MΩ
Temperature Resolution	0.001 °C (0.1 Ω/1 Ω for Thermistors)

Applications

- Precise Temperature Stabilization of Laser Diodes for Interferometry and Spectroscopy
- Control Temperature Set Point via External Input (Active Laser Wavelength Stabilization)
- Cooling of Detectors for Noise Reduction
- Temperature Stabilization of Nonlinear Crystals
- Temperature Stabilization of Industrial Systems

The TED4015 is a high-performance digital temperature controller designed to drive thermoelectric cooler (TEC) elements with currents up to ±15 A. It supports most common temperature sensors and can be adapted to different thermal loads. The TED4015 can be fully controlled via its robust, SCPI-compatible USB interface. The digital PID control offers an auto PID setting function or separate control of the P, I, and D parameters. The TED4015 boasts excellent temperature stability of 0.002 °C within 24 hrs, enhanced safeguard features, and error indicators, making this device ideal for cooling very sensitive devices where high stability, reliability, and precision is required.

Compared to our TED200C Temperature Controller, the TED4015 offers a wider TEC current range plus additional features like full digital control, easy auto PID setting, constant TEC current mode, set temperature protection, TEC voltage measurement, and adjustable temperature window protection. The TED4015 also offers silent operation.

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.

Adaptability to Different Thermal Loads

The TED4015 can easily be adapted to different thermal loads by a digital PID loop. The P (proportional) gain, the I (integral) offset control, and the D (derivative or differential) rates can be individually adjusted by the user or by the auto PID function. With optimum PID parameters, the settling time for a temperature change of 1 °C for a laser mounted in our LM14S2 Laser Diode Mount is less than 2 seconds.

Supported Temperature Sensors

The TED4015 temperature controller supports almost all common temperature sensors. A sensor selection in the Temperature Control Menu allows the use of thermistors up to 1000 kΩ, the use of a temperature sensing IC (such as the AD590) or the use of platinum RTD sensors. The temperature can be displayed in Celsius, Fahrenheit or Kelvin. For thermistors, two temperature calculation methods can be selected: Steinhart-Hart or exponential. The maximum control range is -55 to 150 °C, limited by the rated temperature range of the connected sensor and thermal setup.

Enhanced Security Features

The TED4015 is designed for maximum TEC element protection and stable as well as reliable operation. An adjustable TEC output current limit prevents the controller from overdriving the TEC element. This limit can be set from 0.1 A to the current range of the controller. Adjustable temperature limits and the temperature window protection provide alerts if the temperature of the TEC element exceed certain values.

The system indicates the presence of an incorrect or missing temperature sensor and a bad connection between sensor and controller by an LED on the TEC "On" key and an audible warning signal. The TEC current is automatically switched off if an error occurs.

Temperature Monitor Output

The TED4015 provides a monitoring signal proportional to the difference between actual and set temperature. An oscilloscope or an analog data acquisition card can be connected directly to the rear panel BNC connector to monitor the settling behavior with different thermal loads.

Companion Products

Our LDC200C Laser Diode Controllers are ideal companions for the TED4015. When combined with our TEC laser mounts, the TED4015 can achieve a thermal stability of 0.001 °C. This temperature stability is required for applications like laser diode wavelength tuning and atomic absorption cell spectroscopy.

The TED4015 Ships with the Following Parts:

- Laser Mount Cable for TED4015: 5 A, 17W2, D-Sub-9 (Item Number CAB4000, Also Sold Below)
- DB-9 Connectors: 17W2, Male and Female, with Two High-Current 20 A Contacts (Item Number CON4001, Also Sold Below)
- USB Cable A-B, 2 m
- Driver CD
- Certificate of Calibration
- Operating Manual

Hide Specs

SPECS

Item #	TED4015	
	Front Panel[a]	Remote Control[a]
TEC Current Output		
Current Range	-15 A to +15 A	
Compliance Voltage	15 V	
Maximum TEC Output Power	225 W	
Setting Resolution (Constant Current Mode)	1 mA	0.1 mA
Accuracy	±(0.2% + 20 mA)	
Ripple and Noise (10 Hz to 10 MHz, Typical)	<10 mA rms	
TEC Current Limit		
Setting Range	0.1 A to 15 A	
Setting Resolution	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)[b]	-55 to 150 °C	
Resolution (Temperature)	0.001 °C	
Resolution (Resistance, 100 kΩ / 1 MΩ Range)	0.1 Ω / 1 Ω	0.03 Ω / 0.3 Ω
Accuracy (100 kΩ/1 MΩ Range)[c]	±(0.06% + 1 Ω / 5 Ω)	

Temperature Stability 24 hours (Typical)[b]	<0.002 °C	
Temperture Coefficient	<5 mK/°C	
IC Sensors		
Supported Current Temperature Sensors	AD590, AD592	
Supported Voltage Temperature Sensors	LM335, LM235, LM135, LM35	
Temperature Control Range with AD590	-55 to 150 °C	
Temperature Control Range with AD592	-25 to 105 °C	
Temperature Control Range with LM335	-40 to 100 °C	
Temperature Control Range with LM235	-40 to 125 °C	
Temperature Control Range with LM135	-55 to 150 °C	
Temperature Control Range with LM35	-55 to 150 °C	
Resolution	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	
Pt100/Pt1000 RTD Sensors		
Temperature Control Range	-55 to 150 °C	
Resolution	0.001 °C	0.0003 °C
Accuracy	±0.3 °C	
Temperature Stability (24 Hours, Typical)	<0.005 °C	
Temperture 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	BNC, TTL 5V (Open Collector with Internal 2 kΩ Pull-Up Resistor)	
Temperature Control Output		
Load Resistance	>10 kΩ	
Transmission Coefficient	ΔT x 5 V / T_{win} ± 0.2 % (Temperature Deviation, Scaled to Temperature Window)	
TEC Voltage Measurement		
Measurement Principle	4-Wire / 2-Wire	
Measurement Range	-16.5 V to +16.5 V	
Resolution	100 mV	40 mV
Accuracy (with 4-wire Measurement)	±50 mV	
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 USBTMC/USBTMC-USB488 Specification Rev. 1.0	
Protocol	SCPI-Compliant Command Set	
Drivers	VISA VXIpnp™, MS Visual Studio™, MS Visual Studio.net™, NI LabView™, Labwindows/CVI™	
General Data		
Safety Features	TEC Current Limit, Sensor Fault Protection, Short Circuit when TEC Off, TEC Open Circuit Protection, Temperature Setpoint Limit, Temperature Window Protection, Over Temperature Protection, Keylock Switch	
Display	LCD 320 x 240 pixels	
Connector for Sensor, TE Cooler, TEC On Signal	17W2 Mixed D-sub Jack (Female)	
Connectors for Deviation Out and Temp Ok Out	BNC	
Connector for Digital I/O	Mini DIN 6	
Connector for USB Interface	USB Type B	
Chassis Ground Connector	4 mm Banana Jack	
Line Voltage / Frequency	100 to120 V and 200 to 240 V ± 10% / 50 to 60 Hz ± 5%	
Maximum Power Consumption	600 VA	

Mains Supply Overvoltage	Category II (Cat II)
Operating Temperature (Non Condensing)	0 to 40 °C
Storage Temperature	-40 to 70 °C
Relative Humidity	80% Up to 31 °C Max, 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	5.3 kg
Dimensions (W x H x D) w/o Operating Elements	263 mm x 122 mm x 307 mm
Dimensions (W x H x D) with Operating Elements	263 mm x 122 mm x 345 mm

a. Via front panel the resolution is limited by the display. Via Remote Control a higher resolution is offered.
b. Control range and thermal stability depend on thermistor parameters.
c. Dependent on the selected measurement range.

All technical data valid at 23 ± 5 °C and 45 ± 15% relative humidity

Hide Front & Back Panel

FRONT & BACK PANEL

TED4015 Front Panel

Click to Enlarge

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

TED4015 Back Panel

Click to Enlarge

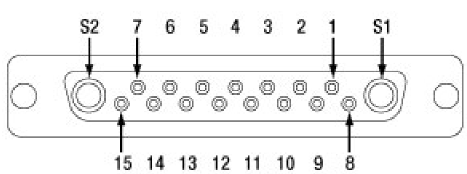
Callout	Connection	Callout	Connection
1	Actual Temperature Deviation Output "Deviation Out" -5 to 5 V	6	USB Connector
2	TTL Temperature Monitor Output "Temp OK Out" 5 V	7	4 mm Banana Jack for Chassis Ground
3	Serial Number of the Unit	8	MiniDin-6 Jack "Digital I/O"
4	Cooling Fan		
5	TEC Element Output and Temperature Sensor Input "TEC Output"	9	Power Connector and Fuse Holder "Line In"

Hide Pin Diagrams

PIN DIAGRAMS

TEC Output

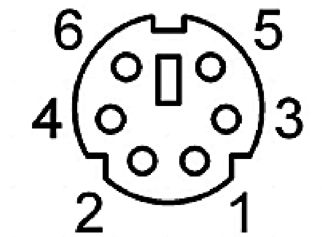
17W2 Mixed D-Sub Jack



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 (-)		

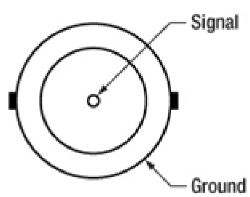
Digital I/O Ports



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)

Deviation Out

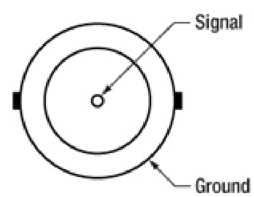
BNC Female



Actual Temperature Deviation Output, -5 to +5 V

Temp OK Out

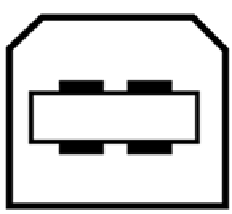
BNC Female



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

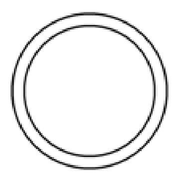
Computer Connection

USB Type B



USB Type B to Type A Cable Included

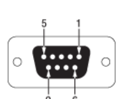
Ground



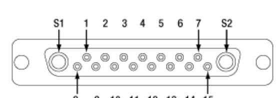
4 mm Banana Jack for Chassis Ground

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

Pin Matching	
DB-9 Pin	17W2 Pin(s)

DB-9 Connector Colors	
Pin	Color

17W2 Connector Colors			
Pin	Color	Pin	Color

1	1, 15
2	4
3	3
4	2, S1
5	9, S2
6	No Connection
7	10
8	5, 12
9	11
Shield	Shield

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

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

Hide Display Screens

DISPLAY SCREENS

Sample Screens of the TED4000

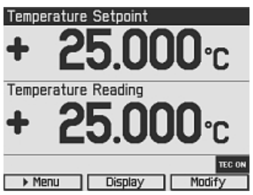
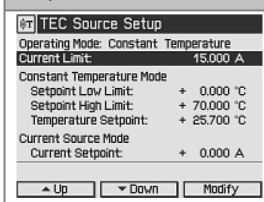
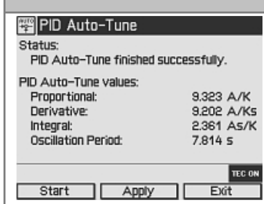
Measurement Screen		Menu Screen	
	The top of this screen shows the Temperature Setpoint: temperature in Constant Temperature Mode and current in Constant Current Mode. At the bottom the actual measured value is shown. The units depend on the attached sensor. Peltier Current, Peltier Voltage and Peltier Power can be shown as well. A status line shows warnings and error-messages.	-	The menu screen allows selecting different operation modes and options.
Temperature Controller Screen		**Temperature Mode Settings Screen**	
	Via the Temperature Controller Screen all parameters for the temperature controller are entered: Operation Mode, Current Limit, Current Control Mode Settings, Temperature Sensor Settings.	-	This Screen offers access to the PID and Temperature Limit Settings.
PID Auto-Tune Screen		**Preference Screen**	
	Via this Screen the PID auto parameter function is started. The TED4000 selects optimal PID parameters for the current settings.	-	This Screen offers access to the device preferences, i.e. operation and display modes.

Figure text for image 1:

Figure text for image 2:

Figure text for image 3:

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 Technical Support for assistance.

Hide Shipping List

SHIPPING LIST

The TED4015 ships with the following components:

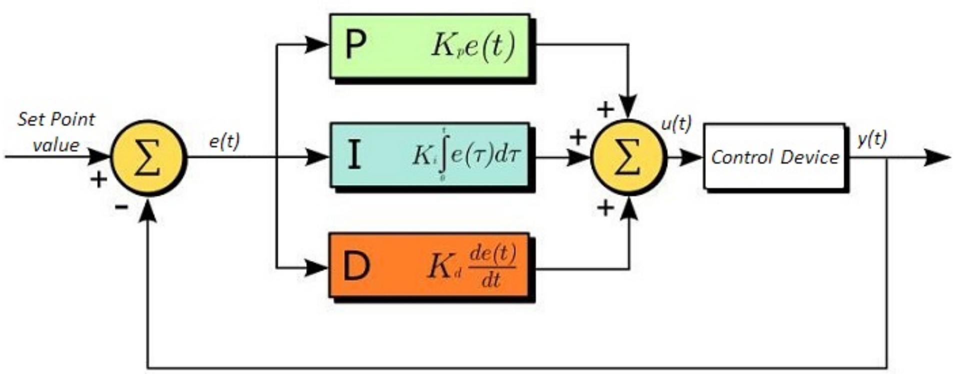
TED4015	Component
x	Benchtop Temperature Controller, ±15 A/225 W (TED4015)
x	Cable TED4000 to laser mount, 5 A, 17W2, D-Sub-9 (CAB4000)
x	USB Cable A-B, 2 m
x	Operation Manual TED4015
x	Distribution CD 4000 Series
x	Mixed D-Sub connector 17W2, male & female with 2 high current contacts each, 20 A (CON4001)

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

	K	K	K

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	p	i	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 Benchtop TEC Controller

Benchtop TEC Controller

Part Number	Description	Price	Availability
TED4015	**Benchtop TEC Controller, ±15 A / 225 W**	**$3,728.98**	**Today**

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 TED4015 temperature controller or our ITC4000 series dual current / temperature controllers 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 cable, please see the *Pin Diagrams* tab.

Please note that one CAB4000 cable and one CON4001 connector set are included with the purchase of a TED4015 benchtop controller.

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 TED4000 Series Calibration Service

TED4000 Series Calibration Service

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-TED4000	**Recalibration Service for TED4000**	**$243.48**	**Lead Time**