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TECSource™

5300 SERIES

USER'S MANUAL



TEMPERATURE CONTROLLER

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Introduction

Thank you for choosing the **5300 Series TECSource** from Arroyo Instruments. Your **TECSource** is a combination of leading edge technology combined with years of experience in the field of temperature control.

With a crystal clear VFD display, high power outputs, multi-sensor support, both RS232 and USB computer interfaces, and small footprint, the **TECSource** will fit into almost any temperature control application.

Unlike other temperature controllers in its class which use inexpensive 7-segment LED displays, the **TECSource** takes advantage of its large VFD display to simultaneously display set point temperature, actual temperature, current, and voltage.

The user interface of the **TECSource** is engineered to make using the instrument straightforward. With its text-based menus, there is never any confusion over which setting is being changed, and parameters are displayed in clear English (no cryptic numbers or LEDs to decode).

The **TECSource** offers all the features you would expect from a modern temperature controller, including:

- AutoTune for automatic PID parameter calculation
- 0.004°C temperature stability
- 0.01°C resolution for both set point and actual temperatures
- 60W (5A/12V) and 120W (10A/12V) output power

What's in the Box

Along with the **TECSource** itself, a CD with electronic copies of this manual, the ***Computer Interfacing Manual***, and USB drivers are included. For USA customers, a power cord is included. For non-USA customers, an IEC-60320-C13 rated AC power cord must be provided.

Accessories

Arroyo Instruments also sells several accessories designed to work with the **TECSource**. These include:

- **TECSource Cable, 2m (p/n 1260B)**
  This cable has DB-15 male/female connectors for interfacing to the LaserMount or other connectorized fixtures, includes wiring for the fan interface, and supports up to 5A of TE current. A pigtailed version of

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this cable, with tinned ends for soldering into custom solutions, is available as p/n **1261B**.

- **TECSource Cable, 10A, 2m (p/n 1262B)**
  Similar to the 1260B cable, but designed to support up to 10A of TEC current, and also adds wiring for the remote sensor inputs. This cable must be used when going above 5A. A pigtailed version of this cable, with tinned ends for soldering into custom solutions, is available as p/n **1263B**.
- **4300/5300 Series 2U Rack Mount Kit, 1 unit (p/n 1401-RM-1)**
  4300/5300 Series 2U Rack Mount Kit, 2 units (p/n 1401-RM-2)
  For installing your **5300 Series TECSource** or **4300 LaserSource** into a standard 19" rack. The **1401-RM-1** is used when installing a single instrument into a 2U rack space. For mounting two instruments side-by-side, use the **1401-RM-2** rack mount kit. A **1401-RM-1** cannot be converted to a **1401-RM-2**, or vise versa, to be sure to purchase the correct rack mount kit.
- **10kΩ Thermistor (p/n 1600)**
  Accurate to ±0.2°C.
- **RS-232 NULL Cable, 3m (p/n 1200-NULL)**
- **USB Cable, 3m (p/n 1201)**

Safety Terms and Symbols

The following safety-related terms are used in this manual:

- **Warnings** (noted by the WARNING heading) explain dangers that could result in physical injury or death;
- **Cautions** (noted by the CAUTION heading) explain conditions that could result in damage to the instrument, other equipment, or your device.
- **Notes** (noted by the NOTES heading) are ***not*** safety-related, and are intended simply to point out important information.

If, at any time, any of the following conditions exist, or are suspected of existing, discontinue use of the unit until it can be inspected by qualified service personnel:

- Visible damage to the unit, including damage or stress caused during product shipment;
- Storage of the unit outside the standard storage temperature or humidity rating, or prolonged storage under harsh conditions;
- Failure to operate properly.

If needed, contact your distributor or Arroyo Instruments for service or repair to ensure the safety of the product is maintained.

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Symbols

 Power Off

 Power On

 Caution, refer to manual

 Earth ground

 Caution, risk of electric shock

General Warnings

WARNING

This instrument is intended for use by qualified personnel who understand the shock and laser hazards and are familiar with safety procedures required to avoid injury. Read this manual completely before attempting to use this product.

WARNING

To avoid electrical shock, ensure a 3-prong power cord is used, and is plugged into a earth-grounded receptacle. Failure to do so can result in severe injury or death.

CAUTION

There are no user-serviceable parts inside. All service and repair work shall be done by Arroyo Instruments or personnel authorized by Arroyo Instruments. Modifications done by non-authorized personnel will void the warranty. Please see the Service section later in this manual for instructions on how to obtain service for this instrument.

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Quick Start

The **TECSource** was designed with ease of use in mind, and you will likely have little need for this manual for almost all of the features the unit offers. This section will show how you can quickly get the unit up and running in almost no time.

After unpacking the unit, ensure that the voltage selection on the Input Power Connector (IPC) on the back of the unit is set to the correct voltage. This is critical, as incorrect voltages can damage the unit. The **TECSource** is typically shipped in the 120V configuration from the factory, but may be set to your local voltage. Make no assumptions and change the voltage as needed. For more information, refer to the IPC section below.

Once the voltage selection has been completed, plug the AC cord into the unit and into the wall outlet. Turn on the power switch located on the IPC, and the unit will power up, displaying the model information and firmware version number.

Press the MENU button to enter the menu, and using the knob, turn to the right until the **I Lim** setting is displayed. Press the knob to edit the setting, and adjust the limit as appropriate to your Peltier. Press the knob again to save the value. Make the same adjustments to the high and low temperature limits (**T-High Lim** and **T-Low Lim**), as appropriate for your application.

The unit comes pre-programmed for the BetaTHERM 10K3A1 thermistor. If the **TECSource** is being connected to a LaserMount, no changes need to be made, as this is the thermistor used in the mount. However, if you are using manufacturer's thermistor or a different BetaTHERM thermistor, you will need to verify the Steinhart-Hart coefficients are set correctly. Navigate to the **Sensor Coeffs** sub-menu, pressing the knob to enter the sub-menu. Adjust the constants to reflect the values for your thermistor.

Once you have made all your adjustments, press the MENU button to exit the menu (in the future, if you're only changing one value, you do not need to press the knob --- pressing the MENU button while changing a value will save the value and exit).

Next, connect the cable between your LaserMount or other fixture and the Output connector of the **TECSource**. We recommend using our cables as they have been designed to work well with the **TECSource**. If using your own cables, ensure they have been properly wired according to the pin-out of the **TECSource** and your fixture.

Finally, set the set point to an appropriate temperature and press the **Output** button. The output will turn on and you will see the voltage and current begin

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driving the fixture to the set point you have chosen. Depending on the thermal size of your fixture, it may take seconds or several minutes to reach the set point.

If you notice the temperature is oscillating around the set point and not stabilizing, you may need to adjust the **Gain** setting in the menu. You can use the AutoTune feature to automatically calculate the best PID values, or select from a set of eight factory preset values that typically cover most applications. To use the factory gains, if the temperature is quickly jumping up and down, the **Gain** will typically need to be reduced. If the temperature is slowly moving up and down, try a higher **Gain**. You may need to experiment with several gain settings to find the ideal value, and for even finer control, you can set the **Gain** to *PID* and directly set the PID control values.

It's that simple. For more detailed operating and installation instructions, read on.

Installation

Installation of the **TECSource** is very straightforward, as the quick start section above illustrated. This section will provide additional details and considerations for installing your **TECSource**.

After unpacking the unit, make sure all packing materials have been removed and nothing obscures the ventilation ports on the back and bottom of the unit.

Changing the Voltage Selection

Before powering on the unit, ensure that the voltage selection on the IPC is set correctly. Improper voltage selection can easily damage the unit. Changing the voltage selection requires that you remove the voltage selection module from the IPC.

Remove the power cord from the unit. Using a small, flat-blade screwdriver, insert the tip of the screwdriver into the two small openings above and below the voltage indication to release the voltage selection module from the IPC, as shown in the picture below.

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Input Power Connector (IPC)

Once the module has been removed, remove the small, white voltage selection tumbler from the module, and then re-insert so that the desired voltage is shown. Re-insert the module into the IPC.

CAUTION

Do not exceed 250VAC on the line input.

It is critical to select the proper voltage selection prior to applying power to the unit. If the actual voltage exceeds the voltage selection by +/-10%, damage to the unit may occur.

Powering Up the Unit

Once the correct voltage selection has been made, connect the AC power cord to the unit.

Turn the power switch, located on the front of the unit, into the on (|) position. The unit will display the current firmware revision, go through a quick power-up self-test, and return to the last known operating state.

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Ventilation

The TECSource has vent holes on the rear and left side of the unit. You must not block these vent holes, or overheating may occur, causing damage to the unit.

CAUTION

Do not operate the unit above +40°C ambient, and ensure the instrument is properly ventilated, or the unit may overheat and possible damage to the instrument may occur.

Rack Mounting

Rack mounting kits (**p/n 1401-RM-1** or **p/n 1401-RM-2**) for standard 19" racks are available for the TECSource, and supports the rack mount of one (**1401-RM-1**) or two (**1401-RM-2**) units in a 2U (3.5") high opening. Because the unit draws air from the side, and therefore inside the rack housing, be sure that the internal rack ambient temperature (which will typically be several degrees higher than room ambient) does not exceed the unit's operating temperature.

Warm-up and Environmental Considerations

In order to achieve the highest level of accuracy, the TECSource should be powered on for at least one hour prior to taking measurements. In addition, ensure that the unit is not operating outside the ambient temperature range or humidity conditions.

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Front Panel Operation

Operation of the **TECSource** is very straightforward. The sections below will help familiarize you with the front panel, the display, and the menu structure.



The front panel is designed for simplicity in operation. There are three buttons on the front panel: **Output**, **Menu**, and the adjustment knob.

The **Output** button is used to turn the output on and off. Whenever the output is on, the blue Output On LED will be lit.

The **Menu** button is used to enter the **TECSource** menu. When in remote mode, it acts as a **Local** button, returning the instrument to local mode.

The large adjustment knob located on the right hand side of the unit is used to change the set point or parameters in the menu. It also acts as a push button, primarily as an enter button, when making changes in the menu. When in the main screen, pressing the knob will change from Normal to Large display mode.

There are four LEDs: a green power LED that is lit whenever the AC power is turned on; the blue Output On LED that indicates the **TECSource** is actively controlling the temperature; a red Error LED that indicates an error has occurred; and a yellow Remote LED that indicates the unit is being controlled via a computer.

Whenever an error is generated, the red Error LED will light, and the error will be displayed on the VFD display. There may be one or more errors, but only the first error will be displayed. To display the next error, press **Menu** button. To clear all errors, press the knob. A list of error codes can be found in the **Error Messages** section below.

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When the unit is in remote mode, the yellow Remote LED will be lit. More information about how the instrument behaves in remote mode can be found in the Remote Mode Operation section below.

Control Modes

The TECSource offers three control modes: constant temperature mode (T Mode), and constant resistance mode (R Mode), and constant current mode (Ite Mode).

Changing the control mode is done through the menu by changing the **Mode** parameter to **T Mode**, **R Mode**, or **Ite Mode**.

Constant temperature mode uses the sensor constants to calculate the resistance of the thermistor at the desired or actual temperature.

While most users will only need the temperature control mode, the constant resistance mode allows you to bypass the sensor equation and directly select the sensor set point. This can be useful when only the desired sensor value is known, or when the sensor-to-temperature conversion values are not available for your sensor.

Main Display Screen

On the main display you will find the set point and two or three measurements, depending on the configuration you have chosen. An example display is shown below:



Sample Display

The set point will depend on the control mode you have selected. When in T Mode, the set point will be temperature. When in R Mode, the set point will be in the active sensor's units (ohms for thermistor and RTD, uA for AD590, and mV for LM335). When in Ite Mode, the set point will be in amps.

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Measurements

The second line of the display contains the measurements appropriate for the control mode. In T Mode, the actual temperature, current, and voltage can be displayed, depending on the display mode. In R Mode, the actual sensor value is displayed instead of the actual temperature. In Ite Mode, the actual temperature is displayed.

No Set Point Error

Because **5300 Series TECSource** uses a digital PID loop, it will always stabilize at the set point, and you will never have a temperature offset, which is different that most other temperature controllers.

Using Limits

The **TECSource** supports three different types of limits: temperature, sensor, and current. There is both a temperature high and temperature low limit, and if the actual temperature exceeds either of these limits, the output will be shut off. Likewise, both high and low limits exist for the sensor (R limits), and the output will be shut off if the sensor measurement exceeds either of these limits.

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Settings and Menus

All parameters of the TECSource can be viewed and changed within the menu. The menus are constructed with the most used parameters first. To change any setting, press **Menu** to enter the menu then rotate the knob to select the parameter to change. Press the knob to begin changing the value. As a visual indication that you are in edit mode, you will see an asterisk appear next to the value. Once you have made your change, press the knob or **Menu** button to store the value. Pressing the **Menu** button will store and exit the menu, while pressing the knob will store the value but leave you in the menu to make additional changes.

Some settings are contained inside a sub menu, such as communications settings. To access the sub menu, simply press the knob to enter the sub menu when its name is displayed.

Below is a complete list of available settings:

Menu	Description	Factory Default
Root Menu	**Main Menu**	
Mode	This set the operating mode (*T Mode*, *R Mode*, or *Ite Mode*) of the temperature controller.	T Mode
Mount	Specify the mount connected to the TECSource. If using a LaserMount, select the appropriate model. Otherwise, select *User Defined*.	User Defined
I Lim	**I Lim** sets the current limit of the temperature controller. The limit should be set to a value that is suitable for your Peltier device.	3A
Gain	**Gain** controls the response of the temperature controller. A higher gain value will cause the controller to respond more quickly to the difference between the set point and the actual temperature, while a lower value will cause it to respond more slowly. Select *PID* for direct access to the PID parameters. Read more on setting gain below.	30
PID P	The proportional term of the PID loop. Will only be available if **Gain** is set to *PID*.	1

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Menu	Description	Factory Default
PID I	The integral term of the PID loop. Will only be available if **Gain** is set to *PID*.	0.01
PID D	The derivative term of the PID loop. Will only be available if **Gain** is set to *PID*.	0
Sensor	Sets the temperature measurement sensor. Can be *Therm 100uA*, *Therm 10uA*, *Therm, LM335*, *AD590*, *RTD*, or *RTD (4-wire)*.	Therm 100uA
T-Low Lim	**T-Low Lim** is the lower temperature limit. If operating in T Mode and the actual temperature drops below this value, the output will be turned off. Temperature limits not monitored in R Mode or Ite Mode. Limit monitoring can also be disabled in software (see TEC:ENAB:OUTOFF command).	-99°C
T-High Lim	**T-High Lim** is the upper temperature limit. If operating in T Mode and the actual temperature rises above this value, the output will be turned off. Temperature limits not monitored in R Mode or Ite Mode. Limit monitoring can also be disabled in software (see TEC:ENAB:OUTOFF command).	125°C
R-Low Lim	**R-Low Lim** is the sensor low limit. If operating in R Mode and the actual sensor measurement drops below this value, the output will be turned off. R limits are not monitored in Ite Mode. Limit monitoring can also be disabled in software (see TEC:ENAB:OUTOFF command).	0.01kΩ
R-High Lim	**R-High Lim** is the sensor high limit. If operating in R Mode and the actual sensor measurement exceeds this value, the output will be turned off. R limits are not monitored in Ite Mode. Limit monitoring can also be disabled in software (see TEC:ENAB:OUTOFF command).	45kΩ
Tol Time	Tolerance time is the amount of time, in seconds, that the actual temperature must be within the set point temperature +/- the Tol Temp value for the unit to be considered in tolerance.	5 seconds

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Menu	Description	Factory Default
Tol Temp	Tolerance temperature is a temperature band (in °C) around the set point temperature. When the actual temperature is within this band for longer than the Tol Time setting, then the unit is considered to be in tolerance.	0.1°C
H/C Mode	This selects the heating and/or cooling mode of the TECSource. See the section below titled "Resistive Heaters and Heat/Cool Only Modes" for more information.	Heat/Cool
Ext Fan	This selects the voltage for the auxiliary fan power supply. See the *External Fan Control* section below for more information.	Off
Ext Fan Pwr	When **Ext Fan** is set to *Custom*, this sets the specific fan voltage from 4.0 to 12.0 volts. See the *External Fan Control* section below for more information.	12.0
Ext Fan Mode	Controls when the fan operates. See the *External Fan Control* section below for more information.	Auto
Ext Fan Off	When **Ext Fan Mode** is set to *Delay*, this setting defines the number of minutes to delay turning off the fan after the TEC output has been turned off. See the *External Fan Control* section below for more information.	5 minutes
Cable R	The resistance of the cable and connectors, in ohms. This setting allows for accurate voltage measurement at the TEC by removing the voltage loss of the cable.	0.0080Ω
T Rate	Selects a desired temperature ramp rate in degrees Celsius per minute. Set to 0.0°C/min to disable rate limiting.	0.0°C/min
Tset Step	Adjusts the increment of the temperature set point from 0.01°C to as much as 10°C per knob tick.	0.01°C

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Menu	Description	Factory Default
AutoTune PID	**AutoTune PID Function**	
	See using the AutoTune Function later in this manual for details on this item.	
Sensor Coeffs	**Sensor Coefficients Menu**	
ThermA	The A term in the Steinhart-Hart equation.	1.12924E-03
ThermB	The B term in the Steinhart-Hart equation.	2.34108E-04
ThermC	The C term in the Steinhart-Hart equation.	0.87755E-07
RTD A	The A term in the RTD equation.	3.98480E-03
RTD B	The B term in the RTD equation.	-0.58700E-06
RTD C	The C term in the RTD equation.	4.00000E-12
RTD R_0	The R_0 term (in Ω) in the RTD equation.	100.00
AD590 M	The slope term in the AD590 correction equation.	1.00000
AD590 B	The offset term, in °C, in the AD590 correction equation.	0.000
LM335 M	The slope term in the LM335 correction equation.	1.00000
LM335 B	The offset term, in °C, in the LM335 correction equation.	0.000
Sens Cal M	The slope term for user sensor calibration of RTD or thermistor measurements.	1.0000
Sens Cal B	The offset term for user sensor calibration of RTD or thermistor measurements.	0.00 Ω
Comm Menu	**Communications Menu**	
Baud	This sets the baud rate for the RS232 serial port. See the ***Computer Interfacing Manual*** which is included on the CD that accompanied this product.	9600
Err While Rmt	To turn off the display of errors while in remote mode, set this value to "No". To display errors while in remote mode, set this value to "Yes".	Yes

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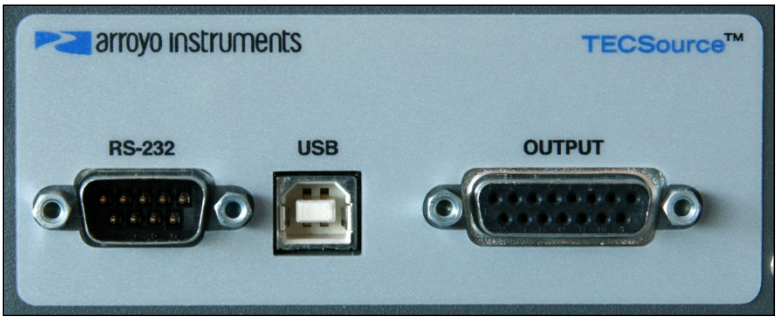
Menu	Description	Factory Default
Terminal Mode	Terminal mode simply echoes any characters received over the serial or USB interfaces.	No
Msg Term	This controls the output message termination, and can be set to CR/LF, CR, LF, or None.	CR/LF
Sys Menu	**System Settings Menu**	
Disp Mode	Display mode, which is used to control the layout on the main screen. *Normal* will display four values, typically the set point temperature, read back temperature, current, and voltage. *Large* will display the read back temperature, sensor, or current, depending on the mode (T, R, or ITE mode, respectively). When changing the set point, the set point will be displayed during the set point change.	Normal
Brightness	The vacuum florescent display can be set to one of eight brightness levels.	100%
Audible Beep	This setting controls when the unit produces audible feedback. Set to No to prevent sound, or Yes or audible alerts such an error messages.	Yes
Lockout Knob	Lockout knob allows you to disable knob operation from the main display. This prevents accidental changes of the set point. The knob will always work in the menus regardless of this setting.	No
Knob Speed	Controls the adjustment speed of the knob. Possible values are slow, medium, and fast.	Slow
ITE Tuning	Enables or disables tuning of the ITE current to prevent over-powering of the heat sink.	Yes
Edit User Cal	Enable or disable editing of user calibration values. This is not a persistent value and will always resets to *No* on power up.	No

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Rear Panel

In addition to the input power connector described above, there are three connectors on the rear panel of the TECSource: Output connector, USB connector, and RS232 connector.



TECSource Rear Panel

TEC Output Connector

The Output connection is a female DB-15, and has the following pin-out:

DB-15 Pin	Description
1, 2, & 9	TE (+)
3, 4, & 10	TE (-)
5 & 6	Earth Ground
7	Sensor+
8	Sensor-
11	Fan+
12	Fan – (Analog Ground)
13	ID
14	Remote Sensor+
15	Remote Sensor-

Output Connector (DB-15 Female)

Using the ID Pin

For operation above 5A, the ID pin (pin 13) must be connected analog ground (pin 12), and make sure all three TE+ and all three TE– pins are connected.

Using Remote Sensor

The remote sensor pins (pins 14 & 15) are used in RTD 4-wire mode, and provide a remote measurement of the RTD voltage to eliminate voltage measurement errors. See *Working With RTDs* below for more information.

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USB Connector

The USB connector is a standard Type B female connector, and can be plugged into any USB 1.1 or USB 2.0 port. For more information on using the USB interface, see the ***Computer Interfacing Manual*** which is included on the CD that accompanied this product.

RS232 Connector

The RS232 connection is male DB-9 connector wired in a NULL modem configuration.

Pin	Description
2	Receive
3	Transmit
5	Ground
1,4,6	Commoned together
7,8	Commoned together
9	No connection
Shell	Earth ground

RS232 Connector (DB-9 Male)

For more information on using the RS232 interface, see the ***Computer Interfacing Manual*** which is included on the CD that accompanied this product.

Connecting to the TECSource

Arroyo Instruments carries two cable assemblies specifically designed for connecting the TECSource to temperature controlled fixtures or devices. The **1260B** is a two meter cable, capable of up to 5A of TEC current, designed for use with Arroyo Instruments mounts, and has DB-15 connectors on both ends, one male and one female. In includes wiring for the fan interface as well.

The **1262B** is identical to the **1260B** cable, but can support up to 10A of TEC current, and should be used whenever operation above 5A is required. The **1262B** also provides wiring for RTD remote sense connections, which are absent from the **1260B** cable.

For custom applications, a two-meter cable with a male DB-15 on one end and bare leads on the other is available. The 5A cable is p/n **1261B**, while the 10A cable is **1263B**.

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NOTE

Connections to the TECSource and the fixture must be secure. Tighten any screws on the DB-15 connectors, and make sure all connections are in good condition.

See the manual for your fixture for additional safety and operational information.

Selecting the Fixture

The TECSource has integrated support for many of the mounts offered by Arroyo Instruments, such as the **204 TEC Butterfly LaserMount**. To simplify operation when using these mounts, you can change the **Mount** setting in the menu to the mount type you are using. By selecting a mount, the current limit, temperature limits, default gain, and sensor settings are automatically adjusted to values appropriate to the mount, and menu settings limited to the capabilities of the mount. For example, when the 204 is selected, the **Sensor** setting is hidden from the menu, and the current limit is adjusted to the mount's rated limit to prevent damage to the mount's Peltier cooler.

Adjusting the **Mount** setting to *User Defined* removes all software limits, allowing unrestricted operation of the TECSource.

Remote Mode Operation

Remote mode operation is when the TECSource is being controlled by a computer over the USB or RS232 interfaces. When in remote mode, the TECSource behaves differently, preventing you from affecting the operation of the instrument. Some of the primary differences are you will not be able to change the set point, you cannot enter the menu, and the knob is disabled.

You can exit remote mode at any time by pressing the MENU button, which has a secondary function to return the TECSource to local operation when in remote mode.

While in remote mode, the Remote LED also acts as an activity indicator, and will flash whenever there is communication with the computer.

Details on how to communicate with the TECSource can be found in a separate ***Computer Interfacing Manual,*** which is included on the CD that accompanied this product.

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Installing the USB Drivers

Using the TECSource via USB is just as simple as using the serial port. In fact, once you have installed the USB drivers, the instrument will appear as a virtual serial port that you can use just like a normal serial port.

To install the drivers, simply plug in the instrument to your computer. When the Add New Hardware wizard appears, insert the CD you received with the TECSource and follow the on-screen instructions.

Once the drivers are installed, to determine the COM port number, go to **Control Panel** and select **System**. Once the **System Properties** dialog appears, choose the **Hardware** tab then click on the **Device Manager** button. When the **Device Manager** appears, click on the plus sign to the left of **Ports**. The port identified as an **USB Serial Port i**s the TECSource. In the event you have multiple TECSource instruments plugged in simultaneously, you will need to experiment to see which instrument was assigned to which port. For example, you could change the set point when the output was off to see which unit's set point changed.

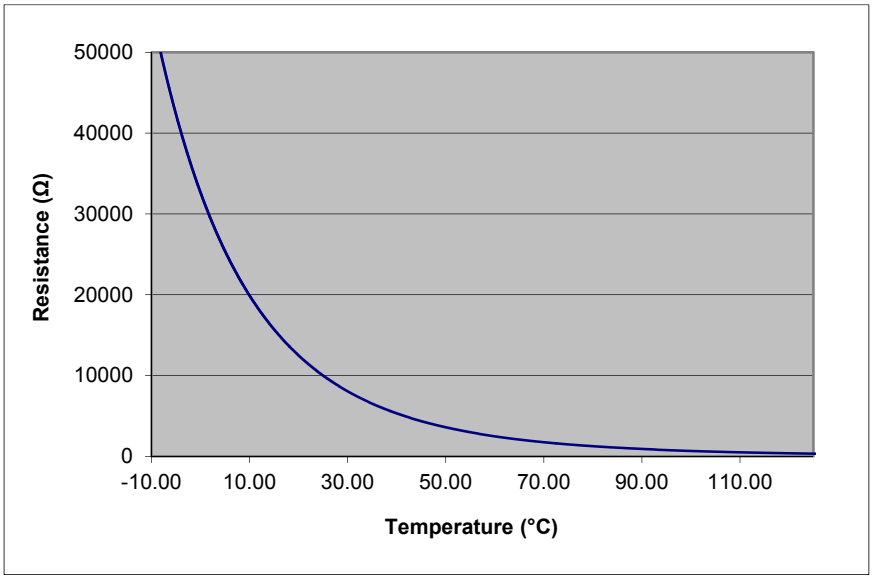
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Working With Thermistors

The **TECSource** is designed to work with negative temperature coefficient (NTC) thermistors, such as the BetaTHERM 10K3A1 thermistor used in the **LaserMounts**. A thermistor works by translating temperature into resistance, with resistance decreasing as temperature increases (hence the 'negative coefficient').

Here is a typical response curve of a thermistor:



Typical Resistance vs. Temperature Graph

As can be seen be the graph, the resistance of the thermistor drops very quickly. In the typical control range (0°C to 40°C), typical 10K thermistors offer good sensitivity to changes in temperature, and this is the range in which most 10K thermistors are typically used. 10K thermistors can be used at much higher temperatures, but will suffer poorer temperature stability performance because of the lower sensitivity. When evaluating the performance of a thermistor, it is important to understand the resistance sensitivity of the thermistor at your application temperature, which varies greatly by temperature and thermistor types.

The **TECSource** supports operation using a 10µA or 100µA constant current source, which limits the upper control range to 450kΩ, 45kΩ, and 4.5kΩ, respectively. To minimize noise and maximize stability, you should select highest current while still allowing you full operation across your required

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temperature range. The typical setting is 100µA, but your application will determine the actual needs.

The Steinhart-Hart Equation

As can be seen from the temperature versus resistance graph above, resistance varies inversely with temperature in a non-linear fashion. This relationship can be accurately modeled by polynomial equations, and one such being the Steinhart-Hart equation:

$$\frac{1}{T} = A + B * \ln(R) + C * \ln(R)^3$$

The coefficients A, B, and C can usually be obtained from the thermistor manufacturer. The **TECSource** defaults to the coefficients for the BetaTHERM 10K3A1 thermistor (A = 1.12924×10^{-3}, B = 2.34108×10^{-4}, C = 0.87755×10^{-7}). You can change the coefficients under the **Sensor Coeffs** menu.

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Working With RTDs

Like thermistors, RTDs also function by converting temperature into resistance, but unlike thermistors, RTDs increase in resistance as temperature increases. RTDs are also a fairly linear device, meaning they can be used across a much broader temperature control range.

According to IEC751, the resistance/temperature relationship is determined using one of two equations, dependent on the temperature or resistance value being measured. For resistances above the R_0 value (resistance at 0°C, typically 100Ω) of the RTD, the following equation is used:

$$R = R_0(1 + AT + BT^2)$$

Below R_0, an additional term is added to the equation:

$$R = R_0[1 + AT + BT^2 + C(T - 100)T^3]$$

In both of these equations, R_0 is the resistance of the RTD at 0°C, and A, B, and C are the coefficients as defined by IEC751, through regression analysis, or by using the Callendar-van Dusen method. By default, the TECSource uses the Laboratory standard coefficients, which are for a 0.003926Ω/ Ω/°C curve (A = 3.9848×10^{-3}, B = -0.58700×10^{-6}, C = 4.0000×10^{-12}, and R_0 = 100).

The **TECSource** automatically determines which equation to use based on the conditions at the time of the measurement.

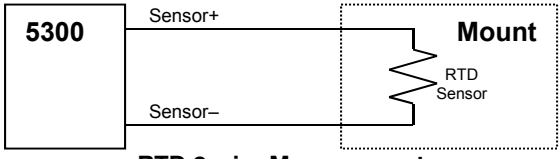
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2-Wire versus 4-Wire Measurements

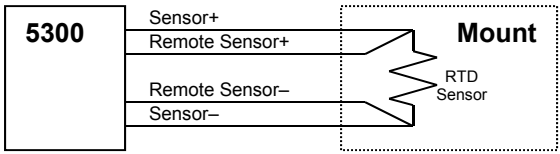
One concern in using RTDs are their relatively low resistance (typically 100Ω at 0°C), and small Ω/°C. Because of these two factors, the resistance of the cable used to connect to the sensor can become a significant error in the sensor measurement. The **TECSource** offers two RTD measurement modes: a conventional two wire measurement mode, which is subject to this error, and a four wire measurement mode that uses separate sensor and source lines to remotely sense the actual resistance of the RTD and eliminate the cable or connector resistances.

When using 4-wire measurement mode, you must select 'RTD (4-wire)' as the sensor type, and then connect the Sensor+ and Remote Sensor+ at one side of the RTD, and Sensor– and Remote Sensor– to the other side of the RTD. Make these connections as close to the sensor as possible.

The drawings below illustrate how 2-wire and 4-wire connections work. Note that 4-wire measurements require all four wires to be brought through the cable to the mount. A **1262B** and **1263B** cable is required for 4-wire measurement mode, as the **1260B** and **1261B** cables do not have the wiring for this input.



RTD 2-wire Measurement



RTD 4-wire Measurement

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User Calibration of Resistance Sensors

In some applications, having the ability to compensate, or calibrate, the sensor measurement is desired, such as referencing to an internal standard or to match the readings of another instrument. This is supported on the **TECSource** by using the **Sens Cal M** and **Sens Cal B** menu entries to apply an offset and/or slope compensation to thermistor or RTD readings (LM335 and AD590 sensors have separate M and B settings).

NOTE

The calibration is applied to the resistance measurement of the sensor, not the temperature. To adjust the resistance-to-temperature conversion, change the thermistor or RTD coefficients as needed.

To prevent accidental modification of the sensor calibration, the **Sens Cal M** and **Sens Cal B** menu entries are only editable when the **Edit User Cal** setting in the **System** sub-menu is set to *Yes*. By default, **Sens Cal M** and **Sens Cal B** values are 1.000 and 0.00, respectively, but can be adjusted to change the sensor measurement. The calibrated measurement is computed as follows:

User calibrated reading = **Sens Cal M** * reading + **Sens Cal B**

Sens Cal B is displayed in kilo-ohms (kΩ) for thermistors, and ohms (kΩ) for RTDs.

Be aware that the there is only a single set of calibration values, and changing sensor type does not change the calibration data. Therefore, if you will be changing between thermistor to RTD sensors, you will need to change the calibration values as appropriate for the new sensor setting. Changing the values back to 1.000 and 0.00 will return the instrument to factory calibration.

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Working With AD590s and LM335s

Unlike thermistors and RTDs, an AD590 or LM335 is considered an "IC" sensor because it has an active transistor element that responds to changes in temperature by producing a current (AD590) or voltage (LM335).

Also unlike thermistors and RTDs, these IC sensors produce a linear response, making conversion to temperature a very straightforward calculation.

AD590 sensors produce 1μA/K, so that 0°C (which is equal to 273.15K) would produce 273.15 μA.

Similarly, LM335 sensors produce 10mV/K, so that 0°C would produce 2.7315V.

For both sensors, because the response is linear, the sensor coefficients default to a slope of 1 and an offset of zero, but can be adjusted to achieve higher accuracy.

The temperature correction formula for the AD590 or LM335 is:

$$T = MT_C + B$$

Where T_C is the temperature (in °C) calculated using the standard conversion value of 1°C/μA or 0.1°C/mV, as appropriate, and adjusted from Kelvin to Celsius.

Controlling the Temperature Rate of Change

Some applications require that temperature is changed at a specific rate to prevent damage that might otherwise come from rapid changes in device temperature. Using the **T Rate** setting in the menu, it is possible to control the temperature ramp rate of the controller, limiting the rate of change to specific degrees Celsius per minute.

Because the temperature rate function relies on the instrument tracking a gradually changing set point, a proper gain setting (or PID values) are important to achieve a smooth and continuous temperature transition.

To disable the temperature rate function, simply set **T Rate** to 0.0°C/min.

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Changing the Set Point Step Size

In many applications, user will manually adjust the instrument between a few set points, such as thermal testing in a production environment. In these applications the high resolution of the temperature set point can actually be a hindrance, as precisely adjusting between 25.00°C and 50.00°C, for example, will entail over- and under-shoots as the operator changes from one set point to the other.

Using the **Tset Step** setting in the menu, you can select a step size of 0.01, 0.05, 0.1, 0.5, 1, 5, or 10°C. In the above application, a step size of 5°C would allow for rapid and easy adjustment between the two temperatures.

Note that the step will adjust based on the current set point, so, for example, if the set point was 25.31°C and the step size was 5°C, the instrument would adjust to 30.31°C, 35.31°C, etc. you may want to adjust the set point to a good starting point before increasing the step size.

Note that changing the step size will not change the resolution of the displayed value for either the set point or the actual temperature.

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External Fan Control

The TECSource has a built-in user adjustable 4-12V DC power supply designed to provide up to 350mA to an external fan, such as those built into the **240 Series** LaserMounts. When using the TECSource with mounts that require a fan, no additional external power supply is needed, and the Arroyo 126xB series cables all include the wiring to connect the fan power to the mount.

Fan control is setup in the menu using the **Ext Fan**, **Ext Fan Pwr**, **Ext Fan Mode**, and **Ext Fan Off** settings.

Ext Fan can be set to *Off*, *Slow*, *Medium*, *Fast*, or *Custom*. When set to *Off*, the fan power is never turned on. *Slow*, *Medium*, and *Fast* correspond to 9V, 10.5V, and 12V. To select a different voltage, choose the *Custom* setting and then adjust the **Ext Fan Pwr** menu item to the desired voltage, from 4.0V to 12.0V.

The fan on/off mode can be controlled using the **Ext Fan Mode** setting. There are five modes:

Auto	Fan is turned on whenever the TEC output is on, and turns off when the TEC output is turned off.
On	Fan is always on.
Delay	Similar to the *Auto* mode, the fan is turned on whenever the TEC output is on, but when the TEC is turned off, the fan will remaining running for an addition number of minutes as defined by the **Ext Fan Off** setting.
Cool	Fan is turned on whenever the TEC output is on and cooling, off otherwise.
Heat	Fan is turned on whenever the TEC output is on and heating, off otherwise.

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Resistive Heaters and Heat/Cool Only Modes

The **TECSource** supports temperature control using resistive heaters instead of Peltier coolers. With resistive heaters, cooling is obviously not possible, and the **TECSource** must be configured to not attempt to cool the output, or a run-away condition will occur when the cooling current actually causes additional heating.

If your application requires, you can also configure the **TECSource** to operate in a cool-only mode. This is only possible with Peltier coolers, as resistive heaters will heat regardless of the direction of current..

To change the cooling mode, adjust the **H/C Mode** setting to *Heat/Cool*, *Heat Only*, or *Cool Only*, as appropriate.

Gain Control and the PID Loop

The **TECSource** supports a fully configurable PID loop, allowing full customization of the PID control parameters. To simplify control, eight standard gain settings are also defined, and many applications can achieve acceptable performance with these predefined gain settings, eliminating the need to understand and adjust the PID loop.

The predefined gains are numbered *1* through *300*, and set using the **Gain** menu setting. Increasing the gain value will increase the speed of the control loop. For full access to the PID parameters, change the **Gain** setting to *PID*, and the individual P, I, and D values will be available as settings in the menu.

The PID parameters function within a mathematical formula as described below:

PID Formula: $$Output = P * \varepsilon + I * \sum \mathcal{E}dt + D * \frac{d\varepsilon}{dt}$$

Where ε is the error in the system, expressed as:

$$\mathcal{E} = \text{Target - Actual}$$

The controller can calculate ideal PID values using the AutoTune function, discussed in detail in the next section.

To manually adjust the PID, start by changing the I and D values to zero, and adjust the P value so that it reaches the set point as quickly as possible without overshooting the set point an unacceptable amount. Gradually increase the I

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value until the set point is achieved without oscillation. In many systems, the D term is not needed and may be left at zero.

For additional information on PID loop tuning, consult online resources such as Wikipedia (http://en.wikipedia.org/wiki/PID_controller) or search for terms such as "Ziegler-Nichols method", or "PID Loop".

Using the AutoTune Function

The **TECSource** is capable of automatically determining PID parameters for most applications. Using a form of the Ziegler-Nichols method, the **TECSource** will step through a process to determine the thermal response of the mount, which can then be used in a mathematical model to calculate the PID parameters.

The PID parameters generated by AutoTune are not necessarily the *ideal* PID parameters, and small improvements may be possible by further refining the results manually.

Before starting the AutoTune function, it is best to begin from ambient conditions, either with the TEC off and the mount stabilized at ambient, or the TEC on and the set point around 25°C. While this is not required, it can produce better results. AutoTune only functions in temperature mode. PID parameters must be manually determined for R mode.

Make sure the current and temperature limits are set prior to starting AutoTune. AutoTune will intentionally cause your mount to oscillate, so the temperature limit should be at least 5 to 10 degrees away from the test point to avoid tripping a limit during the process.

To start the AutoTune function, select the **AutoTune PID** menu entry from the main menu and press ENTER. If you wish to perform AutoTune remotely, see the following section for more information.

The instrument will ask for the AutoTune test point. You will want to select your typical operating point. If you will be operating at two or more set points, you will usually want to select the set point furthest away from ambient. Once the temperature test point is selected, press ENTER.

The instrument asks for a final confirmation to start the AutoTune process. Press ENTER to start, or MENU to exit.

Once the AutoTune process starts, the display will indicate the present temperature, which step it is performing, and the word "AutoTune" will flash on the display.

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Once the AutoTune process is complete, the output will remain on and the display will show "AutoTune Successful". The three PID parameters will also be displayed. Due to display limitations, only the first 2 places of resolution is displayed, but additional resolution is available by viewing the PID parameters in the menu. The **Gain** setting will be changed to *PID*.

If the AutoTune process fails, the instrument will display an E-436 AutoTune Failed error message and turn the output off. Any of the following can cause the AutoTune to fail:

- Noisy temperature measurements, which make it difficult to accurately measure oscillations
- Any condition that causes the output to turn off (temperature limits, sensor limits, etc.)
- Systems with very low P or I terms

In the Auto-Tune fails due to thermal system limitations, you will need to manually modify the PID parameters as described in the section above or select factory gain setting.

You can turn the output off at any time to cancel the AutoTune process, and the PID parameters will remain unchanged (an E-436 will also be displayed).

Using the AutoTune Function Remotely

The AutoTune function can be done remotely, and works essentially the same as local operation. The TEC:AUTOTUNE command starts the process, and requires one parameter, which is the AutoTune temperature test point.

The command will immediately put the instrument into AutoTune mode, and the display will indicate progress in the same way as local operation. The TEC:AUTOTUNE? query can be used to monitor the process of AutoTune. A response of 1 indicates AutoTune is in progress. Once complete, the instrument will respond with a 2 if AutoTune failed or a 3 if AutoTune succeeded. A response of 0 is returned if the instrument has never started an AutoTune process.

Turning the output off remotely will cancel the AutoTune process and generate an E-436 error.

More details on the use of the command can be found in the *Computer Interfacing Manual*.

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Compensating for Cable Resistance

Because the high currents the **TECSource** can drive through the Peltier, the voltage loss through the cable and connectors of the system can significantly affect the TEC voltage measurement. In most cases, accurate voltage measurements are not needed, and the default compensation of the instrument is sufficient. To improve the compensation, the **Cable R** setting in the menu allows you to specify the cable resistance, which is then used to dynamically subtract the voltage drop by simply using the formula V = IR to calculate the voltage loss, where I is the TEC ITE current, and R is the **Cable R** setting. This value is then removed from the voltage measurement to display an accurate TEC voltage measurement.

The safest method of calculating cable resistance is to short the ITE+ and ITE– connections, making sure whatever you are using to short the terminals is not itself adding resistance to the circuit. Use short, heavy gauge wires, preferably soldered onto the terminals to minimize any resistance the short might add. Place the short as close to the Peltier as is reasonable. A simple approach is to unplug the cable from the mount and place a shorting plug on the mount end of the cable, which is easily made from a male DB15 connector and a soldering iron to solder the ITE+ and ITE– pins together. Make sure the Peltier is disconnected to protect it from current overloading during the test.

Change the instrument to ITE mode and set the current to 5A (or the maximum current of your controller, if less). Depending on your setup, you may first need to change the Mount to User Defined and adjust the limit higher. Turn on the output and after the voltage has stabilize, make a note of it and turn the output off. Enter the measured voltage into the following equation to calculate **Cable R**:

Cable R = Voltage / Current

Enter the resulting values into the **Cable R** menu entry and return the instrument to its original configuration. Typical values for **Cable R** are 0.008 to 0.040, but depend on your actual configuration.

Internal Power Management

The **TECSource** is a powerful instrument, capable of delivering upwards of 180W in some custom configurations. When driving a low voltage load at higher currents, a condition can arise where the voltage of the load is too low, and unaddressed, would result in excessive heat inside the instrument.

To manage this internal thermal load, the **TECSource** relies on two methods of power control: a tunable power supply and current limiting. Where possible, the

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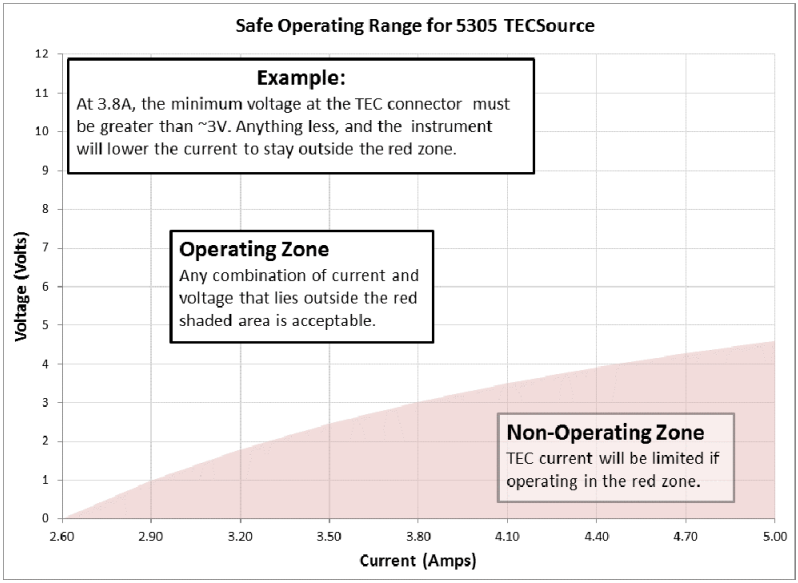
internal power supply will be adjusted down to minimize the thermal load inside the instrument.

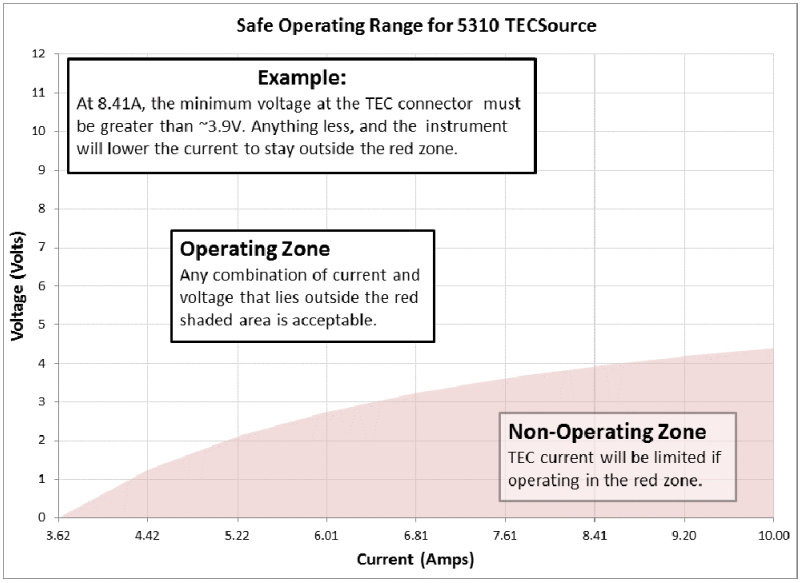
In some cases, power supply adjustments are not enough, and the instrument will then reduce the drive current until the internal thermal load is within the maximum allowable. In many cases, this will have little effect on the operation of your application, but may slow the transition from one temperature to another.

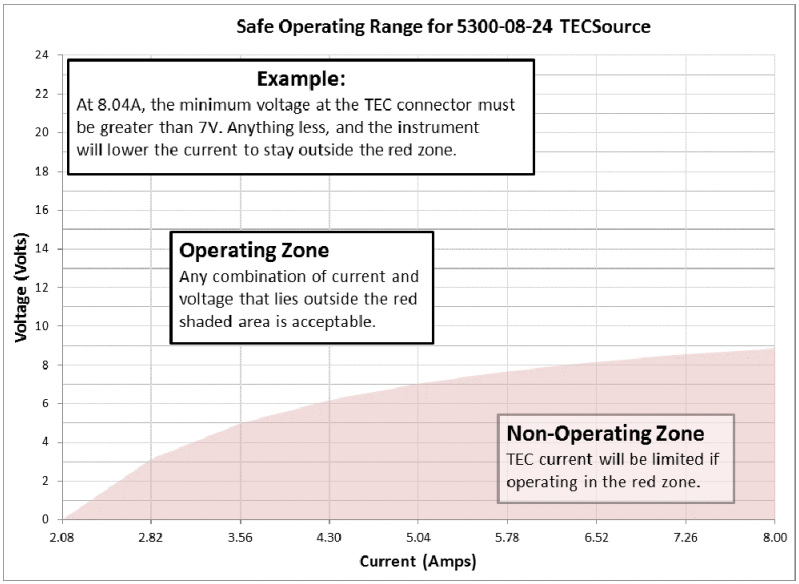
However, there may be conditions where the reduced current actually prevents the mount from achieving the desired operating temperature. The only solution in this case is to increase the load voltage. The simplest method is to wire a power resistor in series with the TEC to create additional voltage. Depending on the voltage of your controller and application requirements, the value of the resistor will vary, but is typically in the 0.5Ω to 1Ω range. Contact the factory for additional support.

When in ITE mode, the current will not be limited, and an error will be generated and the output turned off if operating outside the allowable range.

The graphs below illustrate the minimum voltage requirements for the standard **5305**, **5310**, and **5300-08-24** **TECSource** controllers. Custom configurations will have a different profile.







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Specifications

All values relate to a one-hour warm-up period.

Description	5305	5310	5300-08-24
Drive Channel			
Current			
Range (A)	5	10	8
Compliance Voltage (V)	12	12	24
Max Power (W)	60	120	192
Resolution (A)	0.01	0.01	0.01
Accuracy (±[% set point + mA])	0 + 30	0 + 60	0 + 60
Noise/Ripple (mA, rms)	< 5	< 15	< 15
Temperature Control			
Range (ºC)[1]		-99 to 250	
Resolution (ºC)		0.01	
Thermistor Accuracy (± ºC)[2]		0.05[3]	
AD560 Accuracy (± ºC)[2]		0.05	
LM335 Accuracy (± ºC)[2]		0.05	
RTD Accuracy (± ºC)[2]		0.05	
Short Term Stability (1hr) (± ºC)[4]		0.004	
Short Term Stability (24hr) (± ºC)[4]		0.01	
Measurement Channels			
Current			
Resolution (mA)		10	
Accuracy (±[% reading + mA])	0 + 30	0 + 60	0 + 60
Voltage			
Resolution (mV)		10	
Accuracy (±[% reading + V])		0 + 0.05	
Sensor			
10µA Thermistor			
Range (kΩ)		0.1 – 450	
Resolution (kΩ)		0.01	
Accuracy (± [% reading + Ω])		0.05 + 50	
100µA Thermistor			
Range (kΩ)		0.05 – 45	
Resolution (kΩ)		0.001	
Accuracy (± [% reading + Ω])		0.05 + 5	
LM335			
Bias (mA)		1	
Range (mV)		1730 – 4730	
Resolution (mV)		0.1	
Accuracy (±[% reading + mV])		0.3 + 1	

[1] Software limits. Actual range dependent on sensor type and system dynamics
[2] Accuracy figures are the additional error the 5300 adds to the measurement, and does not include the sensor uncertainties.
[3] 25°C, 100µA thermistor
[4] Stability measurements done at 25°C using a 10kΩ thermistor on the 100µA setting. The number is ½ the peak-to-peak deviation from the average over the measurement period.

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Description	5305	5310	5300-08-24
AD590			
Bias (V)		4.5	
Range (µA)		173 – 473	
Resolution (µA)		0.01	
Accuracy (± [% reading + µA])		0.03 + 0.1	
RTD			
Range (Ω)		20 – 192	
Resolution (Ω)		0.01	
Accuracy (± [% reading + Ω])		0.03 + 0.1	
Current Limit			
Resolution (mA)		10	
Accuracy (±mA)		50	
Other			
Fan Supply		4 – 12V, 350mA max	
TEC Connector		Female DB-15	
Display Type		2x20 VFD	
Computer Interface		USB 2.0 Full Speed and RS-232 (DB-9, male)	
Power		100V, 120V, or 230V (tumbler select), 50/60Hz	
	100W	190W	280W
Size (H x W x D) [inches (mm)]		3.5 (90) x 8.5 (215) x 12 (305)	
Weight [lbs (kg)]	6.2 (2.8)	7.4 (3.4)	7.4 (3.4)
Operating Temperature		+10°C to +40°C	
Storage Temperature		-20°C to +60°C	

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Error Messages

Error Code	Description	Cause
E-100	General Error	The error code is non-specific, and is generally used when no other error code is suitable.
E-102	Message too long	The message is too long to process (USB/Serial only).
E-104	Type not allowed	The RADix type was invalid
E-123	Path not found	The message used an invalid path command (USB/Serial only).
E-124	Data mismatch	The message contained data that did not match the expected format (USB/Serial only).
E-126	Too few or too many elements	The command requires more or less than the number of parameters actually supplied.
E-127	Change not allowed	An attempt was made to change a parameter that cannot be changed, or is currently read-only.
E-201	Data out of range	The message attempted to set a value that was outside the allowable range (USB/Serial only).
E-202	Invalid data type	When trying to parse the message, the data was in an invalid format (USB/Serial only).
E-204	Suffix not valid	An invalid number base suffix (radix) was encountered when parsing a number (USB/Serial only).
E-402	Sensor open, output turned off	A sensor open circuit was detected and the output was turned off.
E-403	Module open, output turned off	A Peltier module open circuit was detected and the output was turned off.
E-404	I limit, output turned off	A current limit was detected and the output was turned off.
E-405	V limit, output turned off	A voltage limit was detected and the output was turned off.
E-406	Thermistor resistance limit, output turned off	The thermistor resistance limit (high or low) was exceeded and the output was turned off.
E-407	Temperature limit, output turned off	The temperature limit (high or low) was exceeded and the output was turned off.
E-409	Sensor changed, output turned off	The sensor type was changed, causing the output to be turned off.
E-410	Temperature was out of tolerance, output turned off	The temperature went out of tolerance and the output was turned off.

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Error Code	Description	Cause
E-415	Sensor short, output turned off	A sensor short circuit was detected and the output was turned off.
E-416	Cal failed	An error occurred during calibration that caused the calibration to fail. The unit is no longer in calibration mode.
E-419	TEC not stable	The TEC is considered stable if the temperature has changed less than 0.02°C for more than 20 seconds.
E-433	Not a TEC	The TEC:CHAN command attempted to select a non-TEC channel
E-434	Ite limit exceeds cable rating	The cable plugged into the unit is not rated to carry the current as set by the current limit. Use a 1262B cable, 1263B cable, or custom cable with ID pin connected to analog ground, or reduce the current limit below 5A.
E-435	Mode Change	A mode change occurred when the output was on, forcing the output off.
E-436	AutoTune failed	The AutoTune process failed. See the "Using the AutoTune Function" for more information.
E-437	AutoTune in T mode only	The AutoTune process is only available in T (temperature) mode. In R mode, the PID parameters much be determined manually.
E-997	Control error, cycle power	A hardware control error occurred, cycle power to resolve. If error continues to occur, contact factory.
E-998	Command not supported	A command was received that is not supported by this instrument.
E-999	Non-specific error	A non-specific error was encountered.

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Maintenance, Calibration and Warranty

Maintenance

The **TECSource** requires no regular maintenance other than product calibration. To clean the instrument, use cotton cloth that is only damp (not wet) with a light solution of soap and water.

Fuses

Under normal operation, you should never need to replace a fuse. However, if either fuse does blow, use only T 250V, 1.0A, IEC 60127-2 5x20mm metric fuses as replacements.

If, after replacing the fuse, it continues to blow, immediately discontinue use of the instrument and contact service for support.

Service

Service and repair for the **TECSource** can be obtained by contacting the distributor from where you purchased the instrument, or directly from Arroyo Instruments. A complete list of distributors is available on the Arroyo web site.

You can contact Arroyo Instruments through one of these methods:

By mail:	Arroyo Instruments 1201 Prospect Street San Luis Obispo, CA 93401 USA
By phone:	+1 (805) 543-1302
By fax:	+1 (805) 543-1303
By email:	support@arroyoinstruments.com
On the web:	http://www.arroyoinstruments.com

In all cases, Arroyo Instruments requires a return materials authorization (RMA) number. You must contact Arroyo Instruments and obtain an RMA number prior to returning your instrument, or the shipment may be rejected and sent back to you.

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Warranty

Arroyo Instruments warrants that this product will be free from defects in material and workmanship and will comply with Arroyo Instruments' published specifications at the time of sale for a period of one year from date of shipment. If found to be defective during the warranty period, the product will either be repaired or replaced at Arroyo Instruments' option.

To exercise this warranty, write or call your local Arroyo Instruments representative, or contact the factory directly at the address given above. You will be given prompt assistance and return instructions. Send the product, freight prepaid, to the indicated service facility. Repairs will be made and the instrument returned freight prepaid. Repaired products are warranted for the balance of the original warranty period or 90 days, whichever first occurs.

Limitation of Warranty

The above warranties do not apply to products which have been repaired or modified without Arroyo Instruments' written approval, or products subjected to unusual physical, thermal or electrical stress, improper installation, misuse, abuse, accident or negligence in use, storage, transportation or handling. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE. ARROYO INSTRUMENTS SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM THE PURCHASE OR USE OF ITS PRODUCTS.

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European Community Declaration of Conformity

EC Declaration of Conformity

CE

I/We

Arroyo Instruments

of

1201 Prospect Street
San Luis Obispo, CA 93401
USA

declare that

5300 Series TECSource Temperature Controller

In accordance with the following directives

EMC Directive: 89/336/EEC
Low Voltage Directive: 73/23/EEC
RoHS Directive: 2002/95/EC89/336/EEC

has been designed and manufactured to the following specifications:

EMC Directive Test Standards

EN 61326 Electrical Equipment for Measurement, Control and Laboratory Use EMC Requirements. This encompasses 10 individual Tests

Low Voltage Directive Test Standards

EN 61010 Electrical Equipment for Measurement, Control and Laboratory Use Safety Requirements.

This Certificate is the Manufacturer's Declaration which states that the **5300 Series TECSource Temperature Controller** is Compliant to the above noted EU Directives and are therefore, eligible to bear the CE MARK. This equipment, as of the listed Date of Manufacture, is technically exempted from the RoHS Directive Requirements, not being classified as consumer electronics equipment.

I hereby declare that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all essential requirements of the Directives.

Paul Corr
(NAME OF AUTHORIZED PERSON)

(SIGNATURE OF AUTHORIZED PERSON)

President
(TITLE OF AUTHORIZED PERSON)

1 February 2011
(DATE OF ISSUE)

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