



## How to Modify PTC Failsafe Setpoint Temperature Circuit Defaults

November, 2009

Page 1

### OVERVIEW

The PTC Temperature Controllers have a feature that is meant to protect a laser diode (or other hardware you're trying to temperature stabilize) in the event that the remote setpoint signal is lost. With NTC sensors, a 0 V setpoint equates to a hot temperature. If the setpoint signal is lost, the controller will drive heating current (at current limit) to match the sensor voltage to the 0 V setpoint. This can potentially cause excessive temperatures at the laser diode.

The failsafe circuit substitutes a "safe" default setpoint voltage when the setpoint voltage drops below a limit.

In the factory default configuration the minimum setpoint is approximately 0.3 Volts. The substitute setpoint is approximately 1.0 V. This correlates to a set point of about 25° C, assuming the system is using a 10 k $\Omega$  thermistor and a 100  $\mu$ A bias current through the thermistor. Since room temperature is usually around 25°C, this is usually a "safe" temperature setpoint default.

Both the trip point and the substitute setpoint can be modified to meet the specific requirements of your application. This application note describes how to configure these parameters.

### NOTES

Please be aware that circuit modifications implemented by the customer will void the Wavelength Electronics warranty. Only factory implemented modifications are warranted. For factory service please contact Wavelength or an authorized distributor.

## MODIFY DEFAULT SETPOINT TEMPERATURE

Two resistors on the PTC printed circuit board set up the default temperature set point value. These resistors are R2 and R6. Both are sized 0805 surface mount, 1 %, 1/10 Watt resistors. From a reference voltage of 3.3 V, R2 and R6 form a voltage divider that sets the temperature set point for this circuit. From the factory R2 is 49.9 kΩ and R6 is 9.76 kΩ. This sets up a voltage of approximately 0.54 V that is subsequently multiplied by two to yield a default set point of 1.0 V when the failsafe circuit is tripped.

$$V_{\text{SETPOINT}} = 2 * V_{\text{REF}} \left( \frac{R_2}{R_2 + R_6} \right)$$

Change either R2 or R6 (or both) to change the default set point voltage to a desired value other than the factory default.

### EXAMPLE:

Let's use an example where we want a default set point of 30° C using a 10 kΩ thermistor as the sensor and a 100 μA bias current through the sensor. From the datasheet, the TCS-610 thermistor is 8056 Ohms at 30° C. Using a 100 μA bias current we would want to establish a default set point voltage of 0.805 V.

$$V_{\text{SETPOINT}} = R_{\text{Thermistor at } 30^{\circ}\text{C}} * I_{\text{BIAS}} = 8056 \Omega * 100 \mu\text{A} = 0.805 \text{ V}$$

Assuming that we only wish to change one resistor in the divider string, we choose to modify R6 to achieve the new default set point voltage. Use the following equation to determine what the value of R6 should be for a set point of 0.805 V.

$$R_6 = \frac{(V_{\text{SETPOINT}} * R_2)}{(2 * V_{\text{REF}} - V_{\text{SETPOINT}})}$$

$$V_{\text{REF}} = 3.3 \text{ V}$$

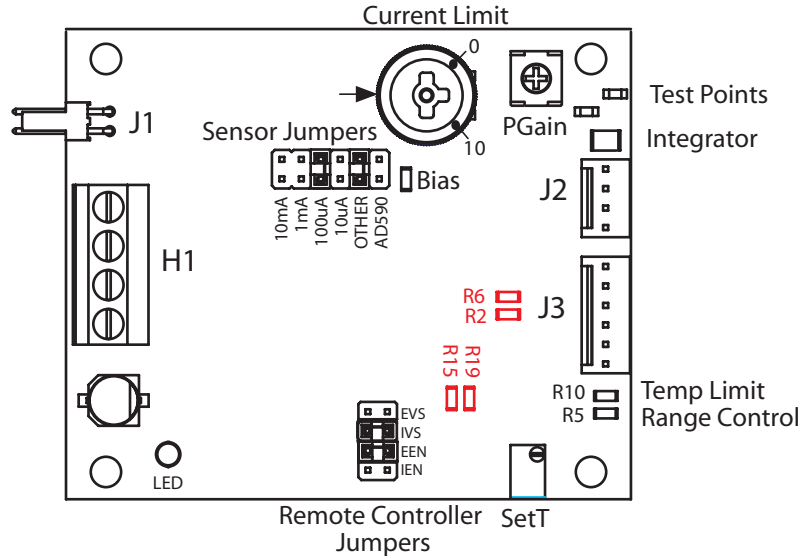
$$V_{\text{SETPOINT}} = 0.805 \text{ V}$$

$$R_2 = 49.9 \text{ k}\Omega$$

$$R_6 = \frac{(0.805 * 49900)}{(2 * 3.3 - 0.805)}$$

$$R_6 = 6.93 \text{ k}\Omega \text{ or approximately } 6.9 \text{ k}\Omega$$

Replacing R6 with a 6.9 kΩ resistor would achieve a new default set point temperature of approximately 30°C for the TCS-610 10 kΩ thermistor at 100μA bias current.



## MODIFY DEFAULT TRIP POINT

The point at which the failsafe set point voltage will be tripped is controlled by the voltage divider string established by resistors R15 (factory default – 100 kΩ, 1%, 1/10 W, 0805 sized) and R19 (factory default – 4.99 kΩ, 1 %, 1/10 W, 0805 sized) from the reference voltage of 3.3 V. The default voltage divider string implements a voltage of approximately 0.157 V that is then multiplied by two to achieve the trip point of about 0.3 V.

$$V_{\text{TRIP}} = 2 * V_{\text{REF}} \left( \frac{R_{19}}{R_{15} + R_{19}} \right)$$

Change either the value of R15 or R19 (or both) to modify the point at which the failsafe set point voltage will be used.

### EXAMPLE:

As an example, consider the case where we want a trip point of 0.25 V. Assuming that we only wish to change one resistor in the divider string, we choose to modify R19 to achieve the new trip point voltage. Use the following equation to determine what the value of R19 should be for a trip point of 0.25 V.

$$R_{19} = \frac{(V_{\text{TRIP}} * R_{15})}{(2 * V_{\text{REF}} - V_{\text{TRIP}})}$$

$$\begin{aligned} V_{\text{REF}} &= 3.3 \text{ V} \\ V_{\text{TRIP}} &= 0.25 \text{ V} \\ R_{15} &= 100 \text{ k}\Omega \end{aligned}$$

$$R_{19} = \frac{(0.25 * 100000)}{(2 * 3.3 - 0.25)}$$

R19 = 3.937 kΩ or approximately 3.9 kΩ

Replacing R19 with a 3.9 kΩ resistor would achieve a new default trip point of 0.25 V.

## DISABLE FAILSAFE CIRCUITRY

To generally disable the Failsafe Circuitry, remove R15. Because of offsets, the failsafe will now trigger when the setpoint is below approximately 50 mV.

## REVISION HISTORY

REV	DATE	NOTES
A	7-Nov-09	Initial Release