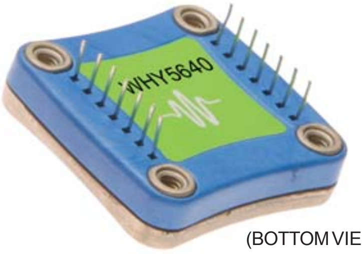
February, 2008

WAVELENGTH
ELECTRONICS

WHY5640

Subminiature Temperature Controller



(BOTTOM VIEW)

GENERAL DESCRIPTION:

The WHY5640 is a general purpose analog PI (Proportional, Integral) control loop for use in thermoelectric or resistive heater temperature control applications. The WHY5640 maintains precision temperature regulation using an active resistor bridge circuit that operates directly with thermistors or RTD temperature sensors. Supply up to 2 Amps of heat and cool current to your thermoelectric from a single +5 Volt power supply.

Connect two or more WHY5640 units together and drive higher output currents.

FEATURES:

- + 5 to + 24V Control Electronics Supply
- + 5 to + 28V Power drive supply
- Low Cost
- 0.008 ˚C Stability (typical)
- PI Temperature Control
- High ± 2 Amps Output Current
- Control Above and Below Ambient
- Small Package Size

Online Design Tools at
www.teamwavelength.com

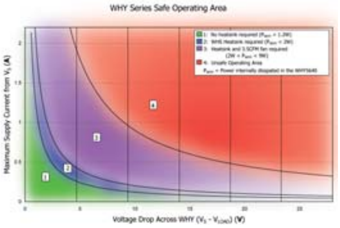
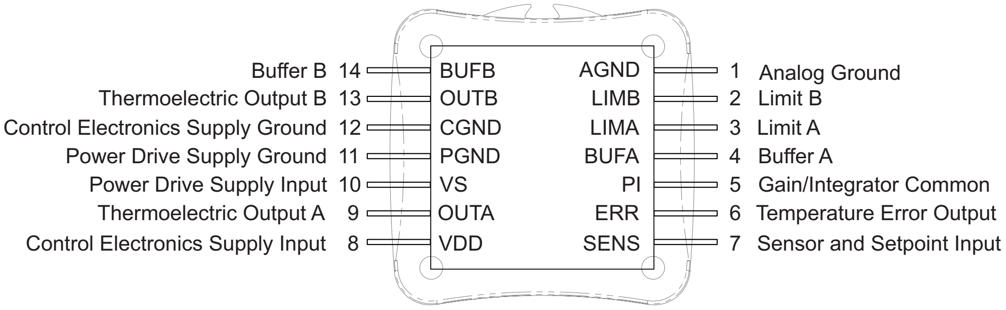


Figure 1

Top View Pin Layout
and Descriptions

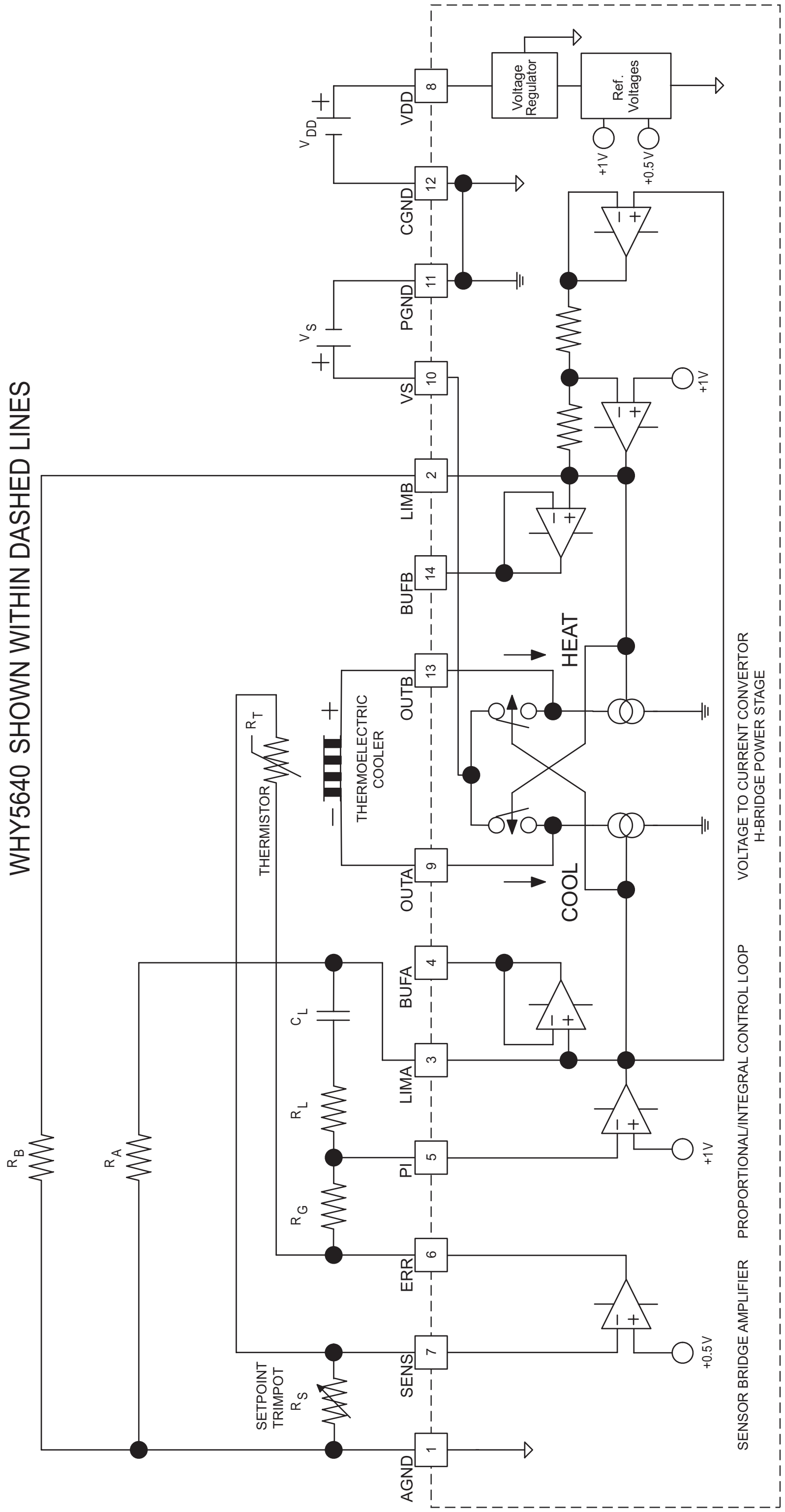
TOP VIEW



IF YOU ARE UPGRADING FROM THE WHY5640 to the WTC3243: The position of Pin 1 on the WHY5640 is reversed (or mirrored) relative to the position of Pin 1 on the WTC3243.

BLOCK DIAGRAM

External Connections
with Thermistor Operation



ELECTRICAL AND OPERATING SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS RATING	SYMBOL	VALUE	UNIT
Supply Voltage 1 (Voltage on Pin 8)	V_{DD}	+5 to +26	Volts DC
Supply Voltage 2 (Voltage on Pin 10)	V_S	+4.5 to +30	Volts DC
Output Current (See SOA Chart)	I_S	±2.2	Amperes
Power Dissipation, $T_{AMBIENT}$ = +25˚C	P_{MAX}	9	Watts
Operating Temperature, case	T_{OPR}	-40 to +85	˚C
Storage Temperature	T_{STG}	-65 to +150	˚C

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
TEMPERATURE CONTROL					
Short Term Stability, 1 hour	T_{SET} = 25˚C using 10 kΩ thermistor	0.001	0.005	0.01	˚C
Long Term Stability, 24 hour	T_{SET} = 25˚C using 10 kΩ thermistor	0.003	0.008	0.01	˚C
Setpoint vs. Actual Temp Accuracy	T_{SET} = 25˚C using 10 kΩ thermistor		<1%		
Control Loop		P	PI		
P (Proportional Gain)		1		100	A/V
I (Integrator Time Constant)		1		10	Sec.
OUTPUT					
Current, peak, see SOA chart			± 2.0	± 2.2	Amps
Compliance Voltage, Pin 9 to Pin 13	Full Temp. Range, I_S = 100 mA	$\vert V_S - 0.7 \vert$	$\vert V_S - 0.5 \vert$		Volts
Compliance Voltage, Pin 9 to Pin 13	Full Temp. Range, I_S = 1 Amp	$\vert V_S - 1.2 \vert$	$\vert V_S - 1.0 \vert$		Volts
Compliance Voltage, Pin 9 to Pin 13	Full Temp. Range, I_S = 2 Amps	$\vert V_S - 1.6 \vert$	$\vert V_S - 1.4 \vert$		Volts
POWER SUPPLY					
Voltage, V_S		5		28	Volts
Voltage, V_{DD}		5		24	Volts
Current, V_S supply, Quiescent			45	90	mA
Current, V_{DD} supply, Quiescent			10	15	mA
INPUT					
Offset Voltage, initial	Pin 5 and 7		1	2	mV
Bias Current	Pins 5 and 7, $T_{AMBIENT}$ = 25˚C		20	50	nA
Offset Current	Pins 5 and 7, $T_{AMBIENT}$ = 25˚C		2	10	nA
Common Mode Range	Pins 5 and 7, Full Temp. Range	0		V_{DD}-1.5	V
Common Mode Rejection	Full Temperature Range	60	85		dB
Power Supply Rejection	Full Temperature Range	60	80		dB
Input Impedence			500		kΩ
THERMAL					
Heatspreader Temperature Rise	$T_{AMBIENT}$ =25˚C	28	30	33	˚C/W
Heatspreader Temperature Rise	With WHS302 Heatsink, WTW002 Thermal Washer	18	21.5	25	˚C/W
Heatspreader Temperature Rise	With WHS302 Heatsink, WTW002 Thermal Washer, and 3.5 CFM Fan	3.1	3.4	3.9	˚C/W

PIN DESCRIPTIONS

PIN NO.	PIN	NAME	FUNCTION
1	AGND	Analog Ground	The analog ground connection is internally connected to Pins 11 and 12 (the power supply ground connections) and eliminates grounds loops for stable operation of the sensor amplifier bridge and limit current resistors.
2	LIMB	LIMIT B	A resistor connected between Pin 2 (LIMB) and Pin 1 (AGND) sets the maximum output current drawn from the Pin 10 (VS) supply input and delivered to Pin 13 (OUTB). This is cooling current when used with NTC sensors.
3	LIMA	LIMIT A	A resistor connected between Pin 3 (LIMA) and Pin 1 (AGND) sets the maximum output current drawn from the Pin 10 (VS) supply input and delivered to Pin 9 (OUTA). This is heating current when used with NTC sensors. Also connect integrator capacitor C_L to Pin 3 (LIMA) when operating the WHY5640 as a standard PI controller.
4	BUFA	BUFFER A	Connect Pin 4 (BUFA) to Pin 3 (LIMA) of another WHY5640 when operating the devices in a master/slave configuration.
5	PI	Proportional Gain/ Integrator Common	When using the WHY5640 as a standard PI controller, connect one end of the proportional gain resistors R_G and R_L to Pin 5 (PI).
6	ERR	Temperature Error Input	When using the WHY5640 as a standard PI controller, connect one end of the proportional gain resistor R_G to Pin 6 (ERR).
7	SENS	Sensor and Setpoint Input	Pin 7 (SENS) is the common sensor bridge amplifier connection for the sensor, R_T, and setpoint, R_S, resistors.
8	VDD	Control Electronics Supply Input	Power supply input for the WHY5640's internal control electronics. Supply range input for this pin is +5 to +24 Volts DC.
9	OUTA	Thermoelectric Output A	Connect Pin 9 (OUTA) to the negative terminal on your thermoelectric when controlling temperature with Negative Temperature Coefficient thermistors. Connect Pin 9 (OUTA) to the positive thermoelectric terminal when using Positive Temperature Coefficient RTDs.
10	VS	Power Drive Supply Input	Provides power to the WHY5640 H-Bridge Power Stage. Supply range input for this pin is +5 to +28 Volts DC. The maximum current drain on this terminal should not exceed 2.5 Amperes.
11	PGND	Power Drive Supply Ground	Connect the V_S power supply ground connection to Pin 11 (PGND). Pin 11 (PGND) and Pin 12 (CGND) are internally connected.
12	CGND	Control Electronics Supply Ground	Connect the V_{DD} supply ground connection to Pin 12 (CGND). Pin 12 (CGND) and Pin 11 (PGND) are internally connected.
13	OUTB	Thermoelectric Output B	Connect Pin 13 (OUTB) to the positive terminal on your thermoelectric when controlling temperature with Negative Temperature Coefficient thermistors. Connect Pin 13 (OUTB) to the negative thermoelectric terminal when using Positive Temperature Coefficient RTDs.
14	BUFB	Buffer B	Connect Pin 14 (BUFB) to Pin 2 (LIMB) of another WHY5640 when operating the devices in a master/slave configuration.

IF YOU ARE UPGRADING FROM THE WHY5640 to the WTC3243: The position of Pin 1 on the WHY5640 is reversed (or mirrored) relative to the position of Pin 1 on the WTC3243.

Caution:

Do not exceed the Safe Operating Area (SOA). Exceeding the SOA voids the warranty.

To determine if the operating parameters fall within the SOA of the device, the maximum voltage drop across the controller and the maximum current must be plotted on the SOA curves.

These values are used for the example SOA determination:

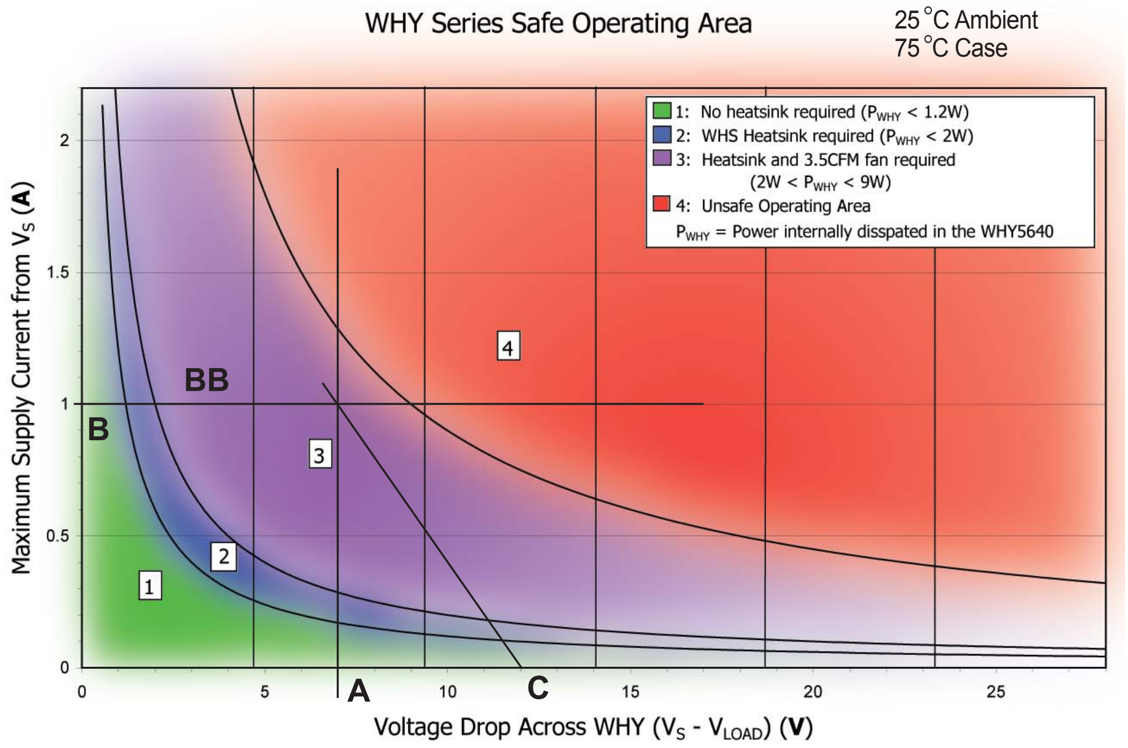
Vs= 12 volts
Vload = 5 volts } These values are determined from the specifications of the TEC or resistive heater
ILoad = 1 amp }

Follow these steps:

1. Determine the maximum voltage drop across the controller ,Vs-Vload, and mark on the X axis. (12volts - 5volts = 7 volts, Point A)
2. Determine the maximum current, ILoad, through the controller and mark on the Y axis:
   (1 amp, Point B)
3. Draw a horizontal line through Point B across the chart. (Line BB)
4. Draw a vertical line from Point A to the maximum current line indicated by Line BB.
5. Mark Vs on the X axis. (Point C)
6. Draw the Load Line from where the vertical line from point A intersects Line BB down to Point C.

Refer to the chart shown below and note that the Load Line is in the Unsafe Operating Areas for use with no heatsink (1) or the heatsink alone (2), but is outside of the Unsafe Operating Area for use with heatsink and Fan (3).

An online tool for calculating your load line is at http://www.teamwavelength.com/tools/calculator/soa/defaulttc.htm.



OPERATION

1. CONFIGURING HEATING AND COOLING CURRENT LIMITS

Refer to Table 1 to select appropriate resistor values for R_A and R_B.

Setting Current Limits Independently Using Trimpots

The 5 kΩ trimpots shown in Figure 3 adjust the maximum output currents from 0 to 2.3 Amps

Heat and Cool Current Limits

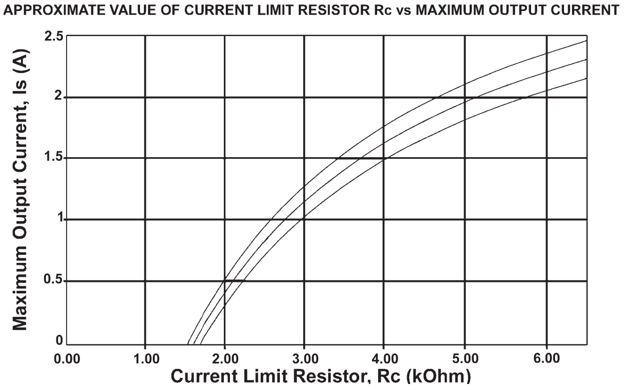


Table 1
Current Limit Set Resistor vs Maximum Output Current

Maximum Output Currents (Amps)	Current Limit Set Resistor, (kΩ) R_A,R_B	Maximum Output Current (Amps)	Current Limit Set Resistor, (kΩ) R_A,R_B
0.0	1.60	1.2	3.05
0.1	1.69	1.3	3.23
0.2	1.78	1.4	3.43
0.3	1.87	1.5	3.65
0.4	1.97	1.6	3.88
0.5	2.08	1.7	4.13
0.6	2.19	1.8	4.42
0.7	2.31	1.9	4.72
0.8	2.44	2.0	5.07
0.9	2.58	2.1	5.45
1.0	2.72	2.2	5.88
1.1	2.88	2.3	6.36

Figure 2
Fixed Heat and Cool Current Limits

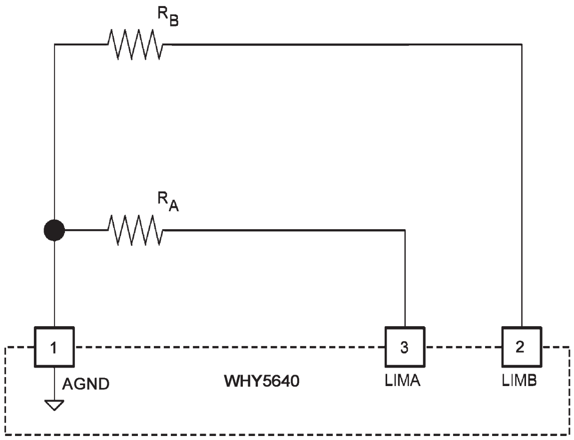
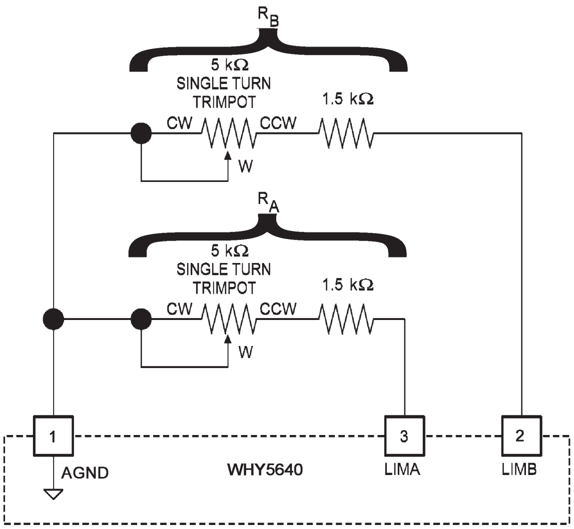


Figure 3
Independently Adjustable Heat and Cool Current Limits



OPERATION

2. RESISTIVE HEATER TEMPERATURE CONTROL

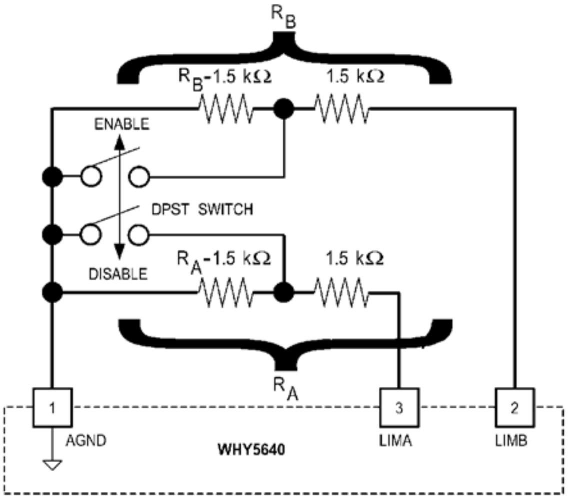
The WHY5640 can operate resistive heaters by disabling the cooling output current. When using Resistive Heaters with NTC thermistors, connect Pin 3 (LIMA) to Pin 1 (AGND) with a 1.5 kΩ resistor.

Connect Pin 2 (LIMB) to Pin 1 (AGND) with a 1.5 kΩ resistor when using RTDs, LM335 type and AD590 type temperature sensors with a resistive heater.

3. DISABLING THE OUTPUT CURRENT

The output current can be enabled and disabled, as shown in Figure 4, using a DPST (Double Pole–SingleThrow) switch.

Figure 4
Disabling Output Current



4. OPERATING WITH THERMISTOR SENSORS

Figure 5 illustrates how to connect the WHY5640 for operation with NTC (Negative Temperature Coefficient) thermistors.

Connect a setpoint resistor, R_S, (or trimpot) across Pins 1 (AGND) and 7 (SENS). Connect the thermistor, R_T across Pins 6 (ERR) and 7 (SENS).

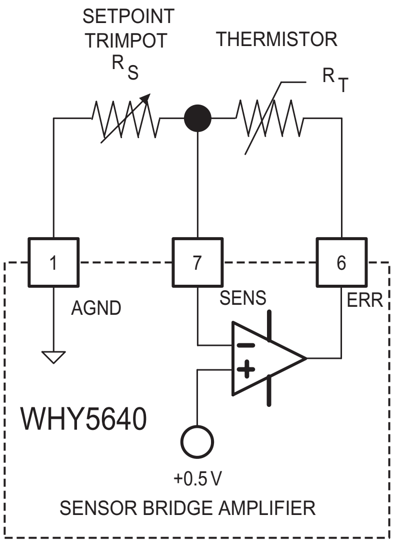
Select setpoint resistor, R_S, equal to the thermistor resistance at the desired operating temperature.

When the setpoint resistor, R_S, and thermistor, R_T, are equal resistance values the Sensor Bridge Amplifier is balanced and the voltage on Pin 6 (ERR) will equal 1 Volt with reference to Pin 1 (AGND).

If the setpoint resistor, R_S, is larger than the thermistor resistance, R_T, then the control loop will produce a cooling current since the temperature sensed by the thermistor is above (hotter than) the setpoint temperature.

If the setpoint resistor, R_S, is smaller than the thermistor resistance, R_T, then the control loop will produce a heating current since the temperature sensed by the thermistor is below (cooler than) the setpoint temperature.

Figure 5
Thermistor Operation



OPERATION

5. USING AN EXTERNAL SETPOINT VOLTAGE WITH THERMISTOR SENSORS

Figure 6 illustrates how to connect the WHY5640 for operation with NTC (Negative Temperature Coefficient) thermistors using an external setpoint voltage to control the desired operating temperature. This setup is useful when operating the WHY5640 in a DAC controlled system.

Equation 1 illustrates how to determine the setpoint voltage, V_{IN}, given a desired thermistor resistance (temperature).

Resistor, R_1, is a fixed resistance value that can be used to scale or adjust the setpoint voltage, V_{IN}, allowing control above and below the ambient temperature. In most applications select resistor R_1 equal to two times the desired operating thermistor resistance, R_T.

NOTE: Pin 9 (OUTA) and Pin 13 (OUTB) must be swapped to maintain the proper heating and cooling current polarity through the thermoelectric. Pin 9 (OUTA) becomes the heating current sink and Pin 13 (OUTB) becomes the cooling current sink.

Example 1 demonstrates how to use an external voltage setpoint to control a 10 kΩ thermistor from a range of 20 kΩ to 0 kΩ.

Figure 7 illustrates the setpoint voltage, V_{IN}, versus thermistor resistance, R_T, for Example 1.

Example 1

Using a 10kΩ Thermistor with External Voltage Control

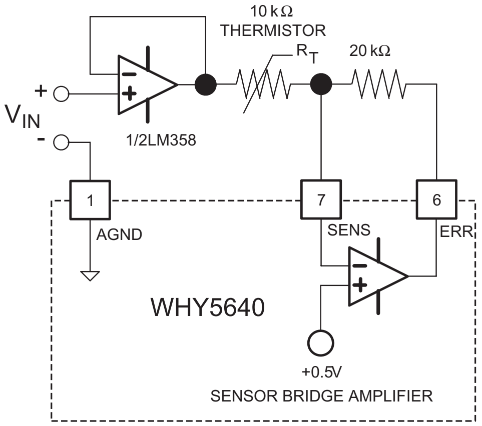
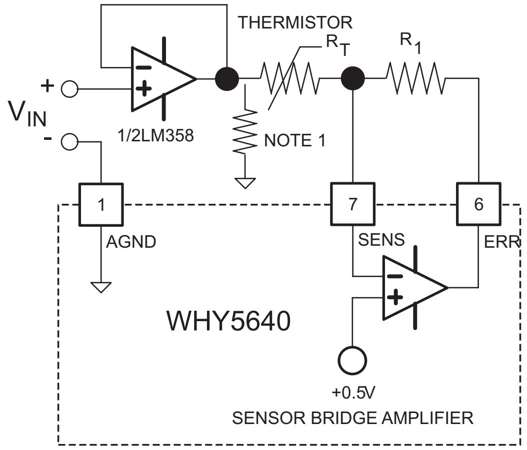


Figure 6

External Voltage Control Using Thermistor Sensors



NOTE 1: If multiple units are controlled by the buffered op-amp, a 100Ω resistor from the op-amp output to ground must be added.

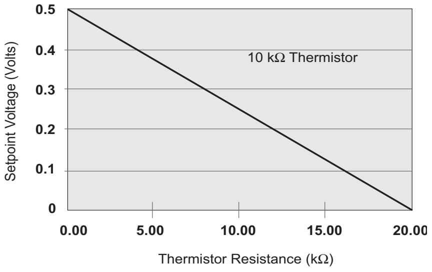
Equation 1

Voltage Controlled Setpoint Using Thermistors

$$V_{IN} = 0.5 - \frac{R_T}{2R_1}$$

Figure 7

Example 1 Setpoint Voltage vs Thermistor Resistance



6. OPERATING WITH RTD SENSORS

Figure 8 illustrates how to connect the WHY5640 for operation with PTC (Positive Temperature Coefficient) RTD sensors (Resistance Temperature Device). Resistors, R_2, should be chosen large enough to prevent self heating of the RTD due to the current flowing through it.

Select setpoint resistor, R_S, equal to the RTD resistance, R_{RTD}, at the desired operating temperature.

When the setpoint resistor, R_S, and RTD, R_{RTD}, are equal in value the Sensor Bridge Amplifier is balanced and the voltage on Pin 6 (ERR) will equal 1 Volt with reference to Pin 1 (AGND).

If the setpoint resistor, R_S, is larger than the RTD resistance, R_{RTD}, then the control loop will produce a heating current since the temperature sensed by the RTD is below (cooler than) the setpoint temperature.

If the setpoint resistor, R_S, is smaller than the RTD resistance, R_{RTD}, then the control loop will produce a cooling current since the temperature sensed by the RTD is above (hotter than) the setpoint temperature.

7. USING AN EXTERNAL SETPOINT VOLTAGE WITH RTD SENSORS

Figure 9 illustrates how to connect the WHY5640 for operation with PTC (Positive Temperature Coefficient) RTD sensors using an external setpoint voltage to control the desired operating temperature. This setup is useful when operating the WHY5640 in a DAC controlled system.

Equation 2 illustrates how to determine the set point voltage, V_{IN}, given a desired RTD resistance (temperature).

Resistor, R_2, is a fixed resistance value that can be used to scale or adjust the setpoint voltage, V_{IN}, allowing control above and below the ambient temperature. In most applications selecting resistor, R_2, equal to two times the desired operating RTD resistance, R_{RTD}.

Figure 8

RTD Operation

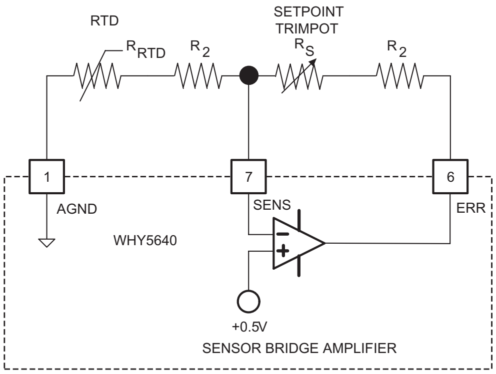
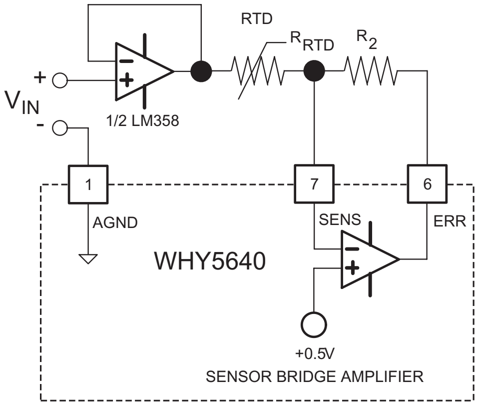


Figure 9

External Voltage Control Using RTD Sensors



Equation 2

Voltage Controlled Setpoint Using RTD Sensors

$$V_{IN} = 0.5 - \frac{R_{RTD}}{2R_2}$$

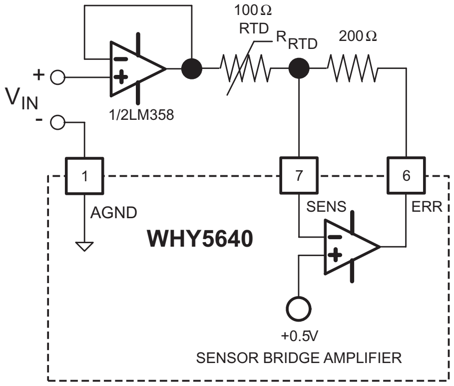
OPERATION

Example 2 demonstrates how to use an external voltage setpoint to control a 100 Ω RTD from a range of 0 Ω to 200 Ω.

Figure 10 illustrates the setpoint voltage, V_{IN}, versus RTD resistance, R_{RTD}, for Example 2.

Example 2

Using a 100Ω RTD with External Voltage Control



8. OPERATING WITH AD590 AND LM335 SENSORS

Figure 11 illustrates how to connect the WHY5640 for operation with PTC (Postive Temperature Coefficient) linear sensors AD590 and LM335.

Equation 3 illustrates how to determine the setpoint resistance, R_S, given a desired operating temperature measured in Celsius.

Resistor, R_3, is a fixed resistance value that can be used to scale or adjust the setpoint resistor, R_S. Select resistor R_3 equal to 10 kΩ for most applications.

Equation 3

AD590 and LM335 Setpoint Resistance Calculation

$$R_S = 2R_3[0.5-(273.15+T_{CELCIUS})(1mV / Kelvin)]$$

Figure 10

Example 2 Setpoint Voltage vs. RTD Resistance

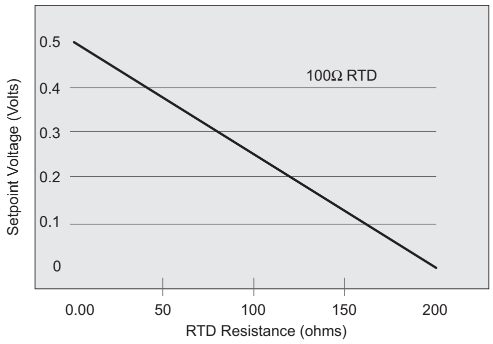
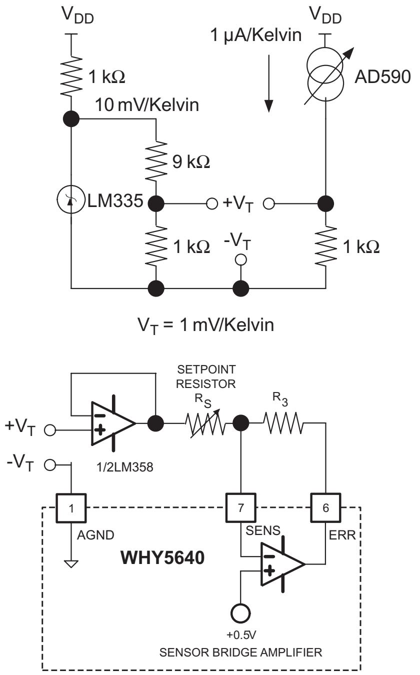


Figure 11

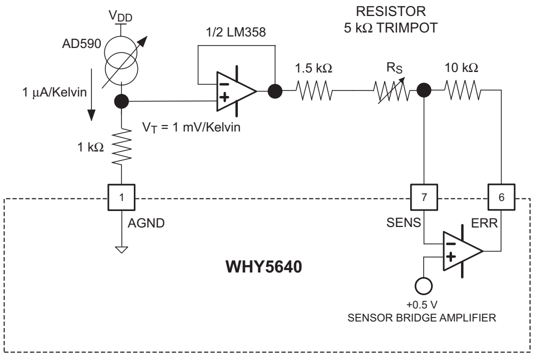
AD590 and LM335 Operation



OPERATION

Example 3

Using an AD590 Example



Example 3 demonstrates how to use an AD590 to control from –50 ˚C to +150 ˚C.

Figure 12 illustrates the setpoint resistance, V_{IN}, versus AD590 temperature, for Example 3.

9. MONITORING SETPOINT AND ACTUAL SENSOR VOLTAGES

Figure 13 illustrates how to configure the WHY5640 so the setpoint and actual sensor voltages can be monitored externally.

The WHY5640 internal sensor bridge amplifier becomes balanced (or Pin 6 (ERR) equals 1 Volt) when the sensor voltage equals the setpoint voltage in Figure 13.

The circuit shown in Figure 13 uses a constant current source to produce a sensing current through the resistive temperature sensors resulting in a sensor voltage. A typical sensing current for 20 kΩ and lower thermistors is 100 µA. For thermistors higher than 20 kΩ use 10 µA. RTDs require a sensing current of 1mA.

Note: PTC (Positive Temperature Coefficient) sensors such as RTD sensors, the AD590, and the LM335 require that the output Pins 9 (OUTA -) and 13 (OUTB +) be reversed from the connection diagram on page 2 to produce the proper cooling and heating currents through the thermoelectric.

When using a 10K Thermistor, per Figure 13, connect the TEC as follows:

OUTPUT B+ ⟶ TEC -
OUTPUT A- ⟶ TEC +

Figure 12

Example 3 Setpoint
Resistance vs AD590 Temperature

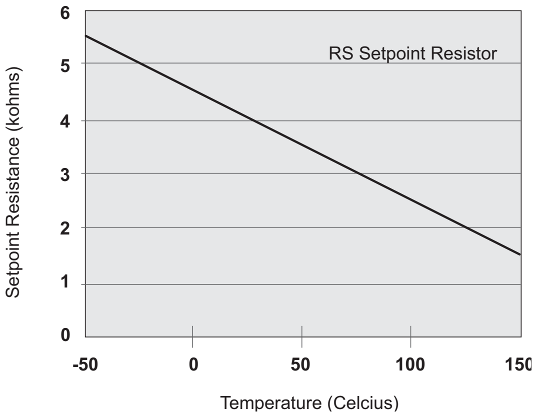
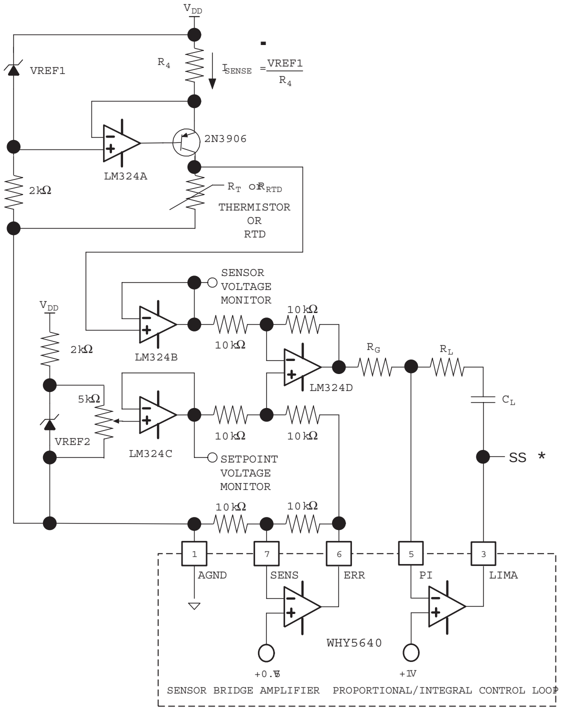


Figure 13

Monitor Setpoint and Actual Sensor Voltages



* Please refer to page 2 for the full wiring of the WHY5640, including the Current Limit circuit.

10. ADJUSTING THE CONTROL LOOP PROPORTIONAL GAIN

The control loop proportional gain can be adjusted by inserting a resistor, R_L, between Pin 5 (P) and Pin 3 (LIMA) and a resistor, R_G, between Pin 5 (PI) and Pin 6 (ERR).

Equation 4 demonstrates how to calculate the Proportional gain, P, given a value for R_L and R_G.

Table 2 lists the suggested resistor values for R_L and R_G versus sensor type and the thermal loads ability to change temperature rapidly.

Equation 4

Calculating P From R_L and R_G

$$P = 4\left(\frac{R_L}{R_G}\right)\text{[Amps / Volts]}$$

Table 2

Proportional Gain Resistor R_L and R_G vs Sensor Type and Thermal Load Speed

R_L	R_G	Proportional Gain [Amps/Volt]	Sensor Type/ Thermal Load Speed
4 MΩ	3.2 MΩ	5	Thermistor/Fast
4 MΩ	800 kΩ	20	Thermistor/Slow
4 MΩ	320 kΩ	50	RTD/Fast
4 MΩ	160 kΩ	100	RTD/Slow
4 MΩ	800 kΩ	20	AD590 or LM335/ Fast
4 MΩ	320 kΩ	50	AD590 or LM335/ Slow

11. ADJUSTING THE CONTROL LOOP INTEGRATOR TIME CONSTANT

The control loop integrator time constant can be adjusted by inserting a capacitor C_L, between Pin 5 (PI) and Pin 3 (LIMA) and a resistor R_G, betwee Pin 5 (PI) and Pin 6 (ERR).

Equation 5 demonstrates how to calculate the integrator time constant, I_{TC}, given values for R_G and C_L.

Table 3 lists the suggested resistor and capacitor values for R_G and C_L versus sensor type and the thermal load's ability to change temperature rapidly.

Equation 5

Calculating I From R_G and C_L

$$I = \left(\frac{R_G C_L}{4}\right)\text{[Seconds]}$$

Table 3

Integrator Time Constant vs Sensor Type and Thermal Load Speed

R_G	C_L	Integrator Time Constant	Sensor Type/ Thermal Load Speed
4 MΩ	7 µF	7	Thermistor/Fast
4 MΩ	10 µF	10	Thermistor/Slow
4 MΩ	1 µF	1	RTD/Fast
4 MΩ	3 µF	3	RTD/Slow
4 MΩ	3 µF	3	AD590 or LM335/ Fast
4 MΩ	10 µF	10	AD590 or LM335/ Slow

12. CHOOSING R_G, R_L, AND C_L

The WHY5640 maintains a constant load temperature using a PI (Proportional Gain, Integrator) control loop. The operation of the PI control loop is dependent on the selection of R_G, R_L, and C_L. Optimum values of R_G, R_L, and C_L can be determined using the following steps.

a.) **Remove C_L From the System**

Short C_L to remove the integrator term. Since both the integrator and proportional terms are dependent upon R_G, removing C_L allows adjustment of the proportional gain without introducing or changing the integrator term.

b.) **Increase the Proportional Gain**

Using Equation 4, increase the proportional gain until the temperature begins to oscillate. This is the critical gain G_C, of the system. Measure the period of this oscillation.

c.) **Decrease the Proportional Gain**

Set the proportional gain to one half of G_C.

d.) **Adjust the Integrator Time Constant**

Using equation 5, select R_G and C_L so that the integrator time constant is slightly longer than the oscillation period of the system.

e.) **Select R_L**

Based on the values of R_G and C_L that have been selected, select a value for R_L to maintain a proportional gain of one half G_C.

13. INCREASING OUTPUT CURRENT DRIVE

The WHY5640 is specifically designed to operate in a master/slave output current boosting configuration. Two or more WHY5640 controllers can be coupled to boost the output current.

Figure 17 shows how to connect two WHY5640 controllers together to increase the output current drive to 4 Amps.

Pin 4 (BUFA) and Pin 14 (BUFB) provide buffered outputs of Pin 3 (LIMA) and Pin 2 (LIMB), respectively. The slave controller is controlled by the master controller by connecting Pin 4 (BUFA) of the master unit to Pin 3 (LIMA) of the slave unit. Similarly, Pin 14 (BUFB) of the master unit then connects to Pin 2 (LIMB) of the slave unit.

Each successive slave unit uses its buffered outputs, Pins 4 and 14, to drive then next slave units output drive section via its Pins 3 and 2. The master controller sets the current limits for all successive slave controllers connected to the master controller, requiring only one set of heat and cool limit resistors.

Use Table 4 to determine the limit setting resistors, R_A and R_B , based on the number of WHY5640 controllers paralleled together.

Table 4

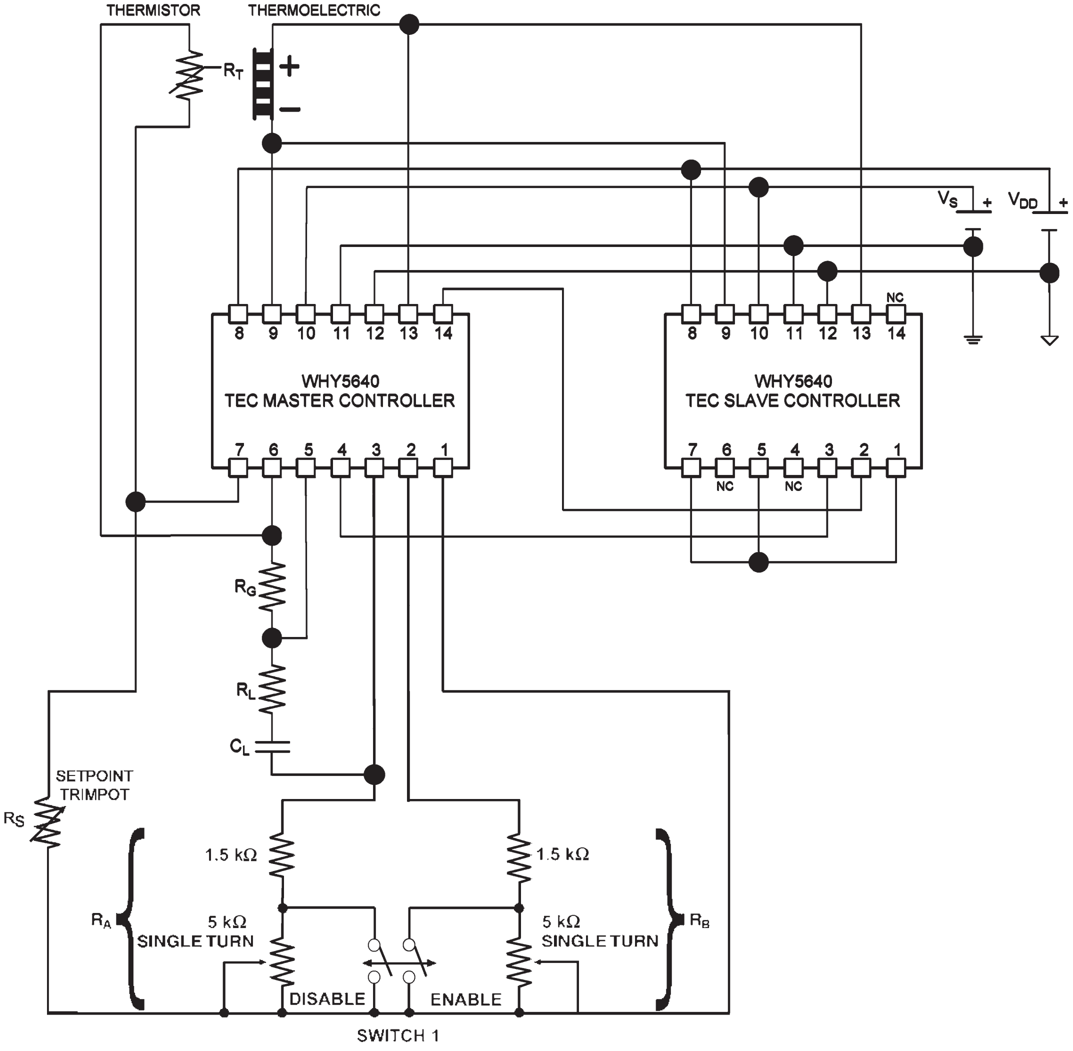
Current Limit Set Resistor vs Maximum Output Current vs Number of Paralleled WHY5640 Controllers.

Maximum Output Current (Amps)					
1 WHY5640 Controller	2 WHY5640 Controllers	3 WHY5640 Controllers	4 WHY5640 Controllers	5 WHY5640 Controllers	Current Limit Set Resistor (kΩ)
0	0	0	0	0	1.60
0.1	0.2	0.3	0.4	0.5	1.69
0.2	0.4	0.6	0.8	1	1.78
0.3	0.6	0.9	1.2	1.5	1.87
0.4	0.8	1.2	1.6	2	1.97
0.5	1	1.5	2	2.5	2.08
0.6	1.2	1.8	2.4	3	2.19
0.7	1.4	2.1	2.8	3.5	2.31
0.8	1.6	2.4	3.2	4	2.44
0.9	1.8	2.7	3.6	4.5	2.58
1	2	3	4	5	2.72
1.1	2.2	3.3	4.4	5.5	2.88
1.2	2.4	3.6	4.8	6	3.05
1.3	2.6	3.9	5.2	6.5	3.23
1.4	2.8	4.2	5.6	7	3.43
1.5	3	4.5	6	7.5	3.65
1.6	3.2	4.8	6.4	8	3.88
1.7	3.4	5.1	6.8	8.5	4.13
1.8	3.6	5.4	7.2	9	4.42
1.9	3.8	5.7	7.6	9.5	4.72
2	4	6	8	10	5.07
2.1	4.2	6.3	8.4	10.5	5.45
2.2	4.4	6.6	8.8	11	5.88
2.3	4.6	6.9	9.2	11.5	6.36

OPERATION

Figure 17

Boosting Output Current Drive



15. HELPFUL HINTS

Selecting a Temperature Sensor

Select a temperature sensor that is responsive around the desired operating temperature. The temperature sensor should produce a large sensor output for small changes in temperature. Sensor selection should maximize the voltage change per °C for best stability.

Table 5 compares temperature sensors versus their ability to maintain stable load temperatures with the WHY5640.

Mounting the Temperature Sensor

The temperature sensor should be in good thermal contact with the device being temperature controlled. This requires that the temperature sensor be mounted using thermal epoxy or some form of mechanical mounting and thermal grease.

Hint: Resistive temperature sensors and LM335 type temperature sensors should connect their negative termination directly to Pin 13 (GND) to avoid parasitic resistances and voltages affecting temperature stability and accuracy.

Avoid placing the temperature sensor physically far from the thermoelectric. This is typically the cause for long thermal lag and creates a sluggish thermal response that produces considerable temperature overshoot.

Mounting the Thermoelectric

The thermoelectric should be in good thermal contact with its heatsink and load. Contact your thermoelectric manufacturer for their recommended mounting methods.

Table 5

Temperature Sensor Comparison of voltage change per degree C.

SENSOR	Thermistor	RTD	AD590	LM335
RATING	Best	Poor	Good	Good

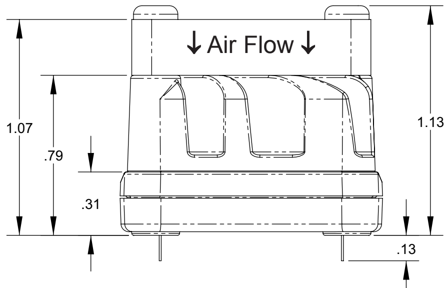
Heatsink Notes

If your device stabilizes at temperature but then drifts away from the setpoint temperature towards ambient, you are experiencing a condition known as thermal runaway. This is caused by insufficient heat removal from the thermoelectric's hot plate and is most commonly caused by an undersized thermoelectric heatsink.

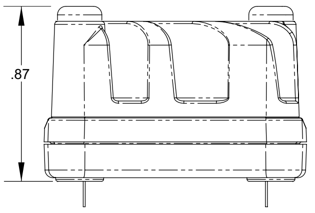
Ambient temperature disturbances can pass through the heatsink and thermoelectric and affect the device temperature stability. Choosing a heatsink with a larger mass will improve temperature stability.

MECHANICAL SPECIFICATIONS

with heatsink and fan

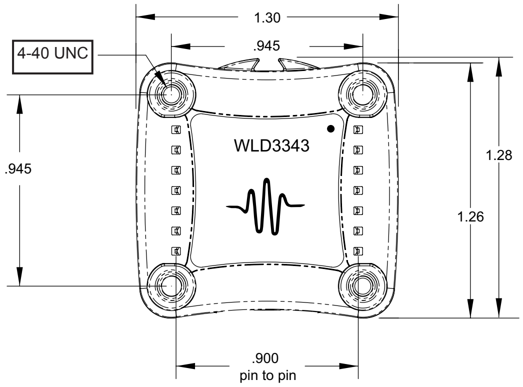


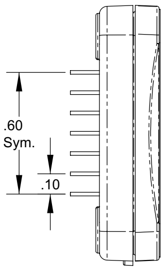
with heatsink



Weights	
WHY5640	.576 oz
WHS302 Heatsink	.512 oz
WXC303/4 Fan	.288 oz

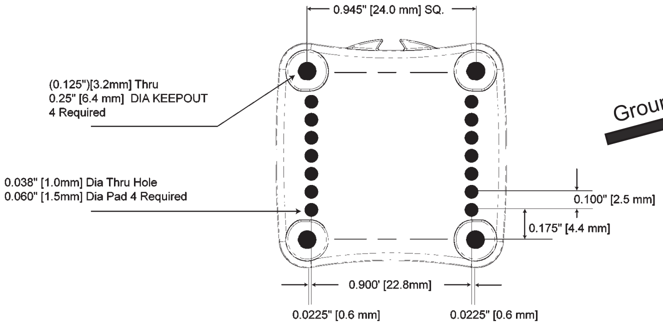
BOTTOM VIEW

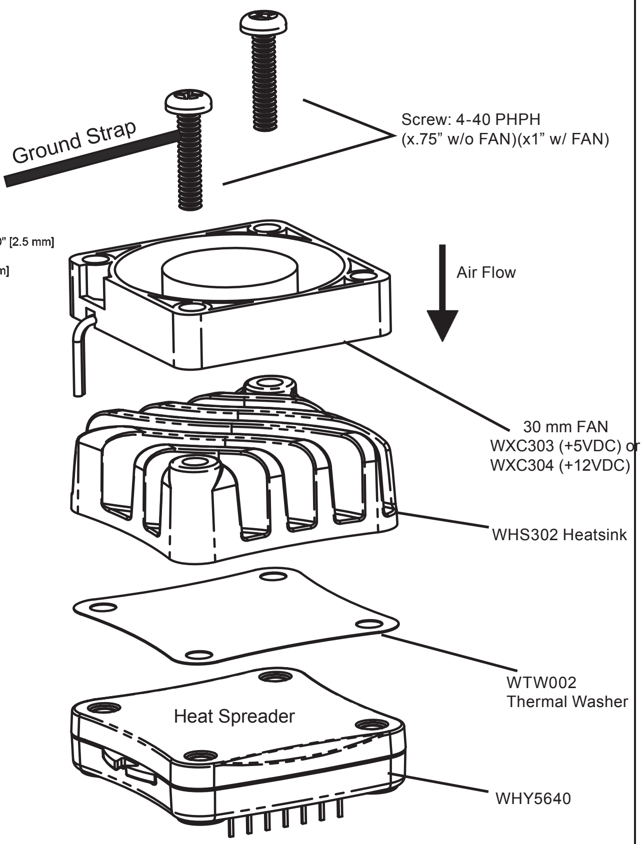




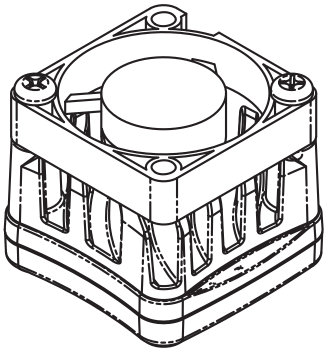
PIN DIAMETER: 0.028”
PIN LENGTH: 0.126”
PIN MATERIAL: Nickel Plated Steel
HEAT SPREADER: Nickel Plated Aluminum
PLASTIC COVER: LCP Plastic
ISOLATION: 1200 VDC any pin to case
THERMAL WASHER: WTW002
HEATSINK: WHS320
FANS: WXC303 (+5VDC)
or WXC304 (+12VDC)

PCB FOOTPRINT





WHY5640 ASSEMBLED WITH HEATSINK & FAN



Noise Reduction: Grounding the heatspreader(metal plate on top of the driver) will reduce noise. In the case where a heatsink or fan is attached, connect the strap on top of the unit with the connecting screws.

CERTIFICATION AND WARRANTY

CERTIFICATION:

Wavelength Electronics (WEI) certifies that this product met it’s published specifications at the time of shipment. Wavelength further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by that organization’s calibration facilities, and to the calibration facilities of other International Standards Organization members.

WARRANTY:

This Wavelength product is warranted against defects in materials and workmanship for a period of 90 days from date of shipment. During the warranty period, Wavelength will, at its option, either repair or replace products which prove to be defective.

WARRANTY SERVICE:

For warranty service or repair, this product must be returned to the factory. An RMA is required for products returned to Wavelength for warranty service. The Buyer shall prepay shipping charges to Wavelength and Wavelength shall pay shipping charges to return the product to the Buyer. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Wavelength from another country.

LIMITATIONS OF WARRANTY:

The warranty shall not apply to defects resulting from improper use or misuse of the instrument or operation outside published specifications.

No other warranty is expressed or implied. Wavelength specifically disclaims the implied warranties of merchantilability and fitness for a particular purpose.

EXCLUSIVE REMEDIES:

The remedies provided herein are the Buyer’s sole and exclusive remedies. Wavelength shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

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SAFETY:

There are no user serviceable parts inside this product. Return the product to Wavelength Electronics for service and repair to ensure that safety features are maintained.

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