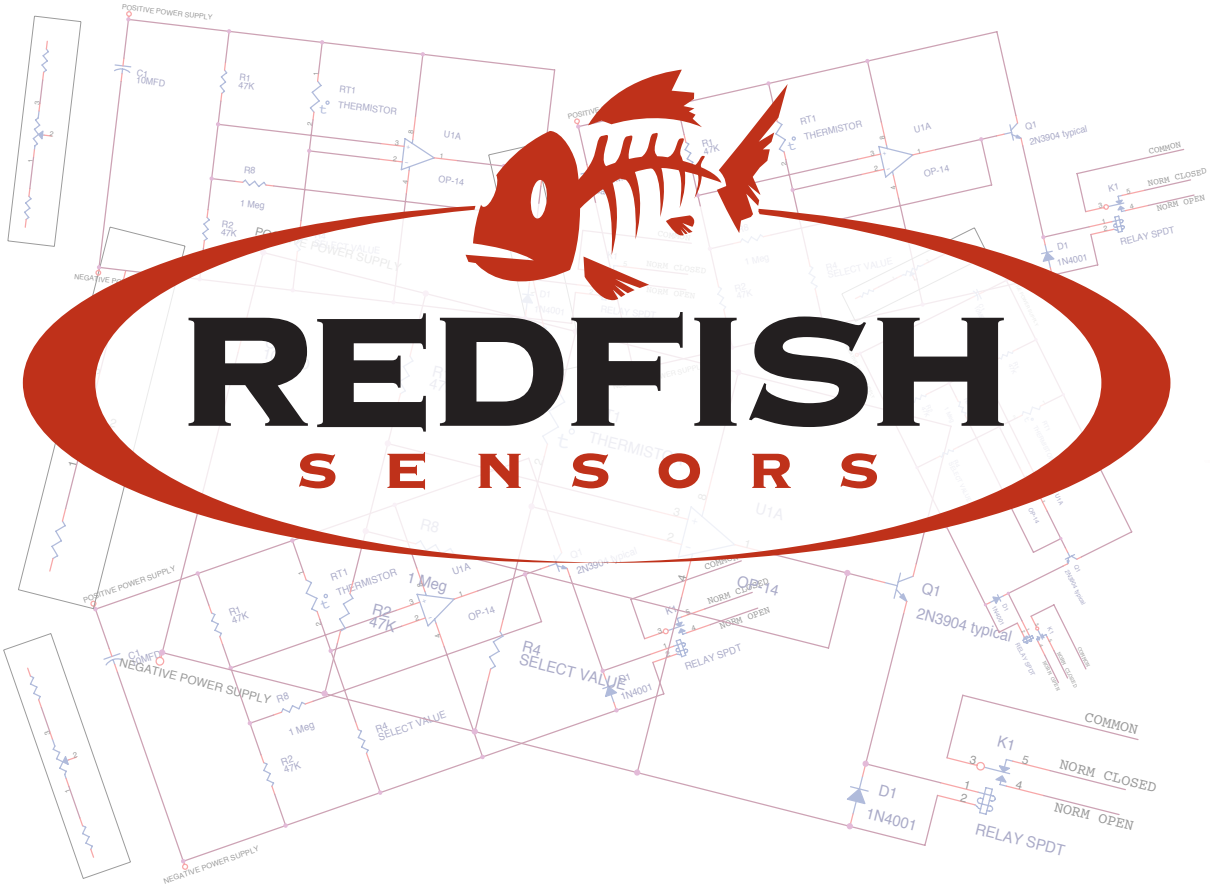
Temperature Controller



REDFISH
SENSORS

How it works!

Temperature Controller

Resistors R1 and R2 form a voltage divider, presenting ½ the power supply voltage to the positive input of the operational amplifier. The thermistor and the resistor form another voltage divider, to the negative input of the amplifier. The exact value of this divider depends on the resistance of the thermistor, which varies with temperature. In this way, the voltage to the negative input to the operational amplifier varies, and the amplifier changes its output depending on which of the two inputs is more positive.

If the temperature is too low, the thermistor resistance is high, and the voltage to the negative input terminal is lower than the positive input. The operational amplifier amplifies this difference and forces the operational amplifier output high, turning on the relay.

The value of R4 should be selected to be equal to the thermistor resistance at the temperature to be controlled. Looking at the Quality Thermistor web page (HYPERLINK "http://www.thermistor.com" www.thermistor.com) you may select a 10K thermistor. Looking at the R/T curve we can see that at 32 degrees Fahrenheit (0 C) the resistance is 34,903 ohms. Choosing a 33K would get us very close to the proper value. Using the two resistor/potentiometer combination would allow you to adjust the voltage divider to exactly 32 degrees. The results of this effort would be that the relay would be energized if the temperature were too low. If you were trying to heat, you would choose the COMMON and NORMALLY OPEN terminal of the relay to turn on a heater. If you were trying to cool, you would choose the COMMON and NORMALLY CLOSED terminals.

We have added a transistor to the output of the amplifier, since the amplifier by itself cannot generate enough current to close the relay. The transistor amplifies the current of the amplifier, and delivers it to the relay.

For the math oriented…

The output of a voltage divider is equal to
Vout = Vin * R1/(R1+R2)
For a thermistor
Vout = Vin * Rthermistor/(Rthermistor+R2)

PARTS LIST

NAME	DESIGNATOR	PART NUMBER	VENDOR NUMBER
Operational Amplifier	U1L	M741CN	276-007
Resistor	R1,R2	47Kohms	271-1342
Resistor	R8	1Megohm	271-1356
Transistor NPN	Q1	2N3904	276-2016
Diode	D1	1N	4001276-1101
8PinSocket	none	none	276-1995
PC Board	none	none	276-150
Relay	K1	none	275-217
Capacitor	C1		

ALTERNATE PARTS

NAME		PART NUMBER	VENDOR NUMBER
Potentiometer		100Kohm trimmer	271-284
		10Kohm trimmer	271-282
		1Kohm trimmer	271-280

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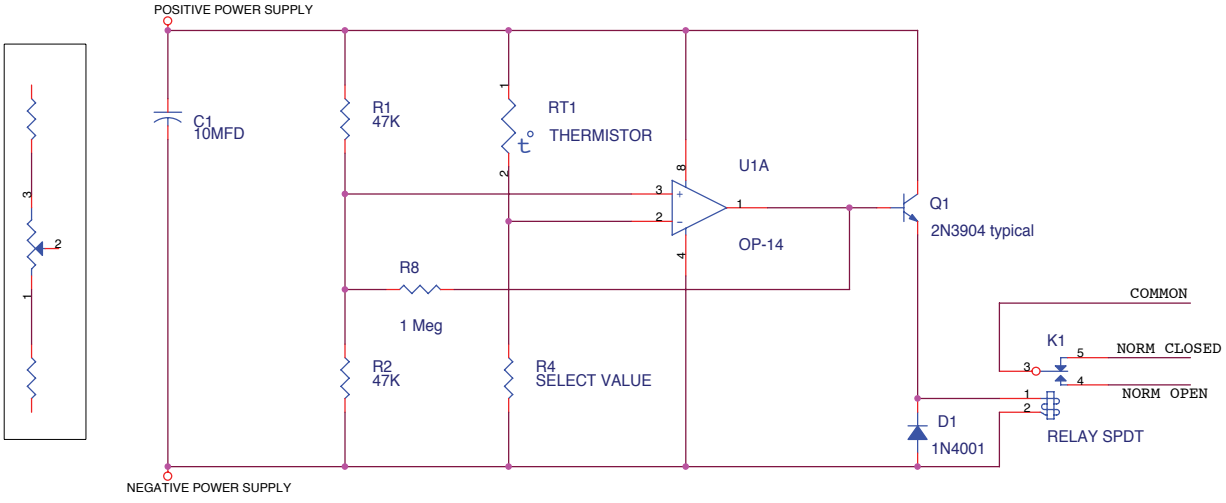
Parts Diagram and Important Notes



NOTES:

R1 and R2 should be equal in value.

RT1 is the thermistor selected.

R4 is equal in value to the thermistor resistance at the control temperature selected.

Select a power supply (such as a 'wall supply') equal to the relay voltage. If you have a 12 volt relay (or 6 volt) , select a 12 volt supply (or 6 volt). Do not exceed 12 volts!

The resistors and potentiometer in the dashed lines may substitute for R1 and R2, if you would like a variable temperature control. Select a potentiometer equal to R1 and R2 for a wide range of control, and a smaller value (5K) for a narrow range.

The relay will be energized when the thermistor resistance is higher (temperature lower) than the set point resistor (R4). Use the relay COMMON wire and the relay NORMALLY OPEN wire to energize your heater. Use COMMON and NORMALLY CLOSED to energize your cooler.

Be sure to select a relay whose contacts are able to handle the voltage and amperage of heater/cooler assembly.

Q1 is any NPN transistor, such as a 2N3904. U1 is any operational amplifier such as an LM741CN.

R8 is added to eliminate any relay 'chatter'. It will determine the difference between the on and off temperatures of the controller. Make it larger in value for smaller differences in control.