Installation Instructions for the Lingenfelter TBRC-001 Temperature Based Relay Controller

PN: L460220000

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CAUTION
IT IS THE PURCHASER'S RESPONSIBILITY TO FOLLOW ALL INSTALLATION INSTRUCTION GUIDELINES AND SAFETY PROCEDURES SUPPLIED WITH THE PRODUCT AS IT IS RECEIVED BY THE PURCHASER TO DETERMINE THE COMPATIBILITY OF THE PRODUCT WITH THE VEHICLE OR THE DEVICE THE PURCHASER INTENDS TO INSTALL THIS PRODUCT ON.
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Parts List
LPE TBRC-001 Temperature Based Ralay Controller Kit (PN: L460220000)

#	Description	Part number
1	TBRC-001 Temperature Based Relay Controller	L460220000
1	TBRC-001 pigtail harness, 36”	XX04851-0003
2	Self tapping screws	AV16037
2	Hook and loop tape, per inch	06483
1	Instructions	N/A

Tools & Materials Required

- Phillips head screwdriver
- Wire crimping tool
- Flat head screwdriver - tip size 1/16”

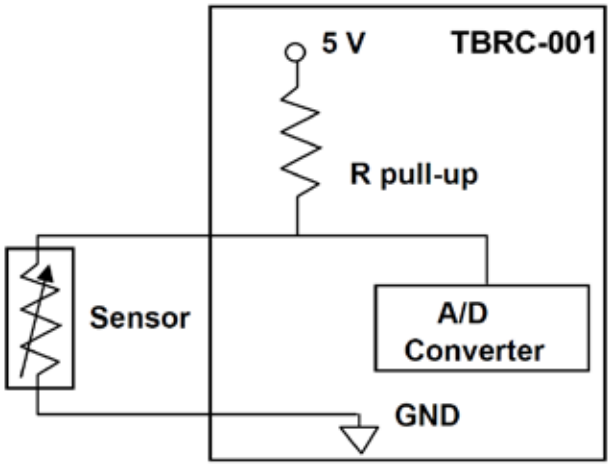
Optional Items

Description	Part number
Two speed dual fan control harness with relays	XX05636-0002
LPE technician’s screwdriver	L950050000
LPE sealed 40 amp relay kit	L450100000
STOV-004 MPH activated switch (for turning off fans based on VSS)	L460340004
Red 7 LED warning light, 10 ft two wire cable	RP-WLRBLK001
Sensors and mating connectors	See table 4 on page 11.

Specifications:

- Works with OEM and aftermarket IAT, ECT, EGT, TFT sensors, including:
  - GM IAT (12160244/12614717)
  - ECT (12608814/12636612)
  - TFT (12458118)
  - Oil temperature sensors (15326388)
  - Bosch 2780071435, 2782569739, 2782650379, 2782610059, 2782412811, 2782334347, 0280130039
  - AEM 30-2012 and other similar fluid temperature sensors
- Works with OEM and aftermarket EGT sensors, including:
  - AEM 20-3050
  - GM 12636612
  - AC Delco 213-4695
  - Bosch PT 200E
  - Sensata TS200–A
  - PT200 RTD
- Built-in Output Cycling Mode.
  - Used in applications where the temperature sensor is installed in-line with the device.
  - 16 timer settings available.
- Reduces the audible noise created by auxiliary cooling system components (fans, pumps, etc...) while increasing their life due to the fact that the components are not in constant operation.
- Custom molded high temperature glass filled Nylon 6 enclosure.
- Fully encapsulated (potted) construction for increased durability.
- Both outputs can be used simultaneously.
- Outputs have a self protect feature and will turn OFF in case of a direct short or over current condition.
- Operating voltage range: 9.0 to 18.0 volts.
- Input signal impedance: 100k ohms.
- Outputs rated for up to 0.75 amps each.
- Current draw: 0.1 amp plus current draw of device being controlled (when active).
- Internal pull-up resistor value: 2.2 k ohms.
- 1 Year warranty (from date of purchase).

Figure 1: Sensor circuit with TBRC-001’s internal pull-up resistor.



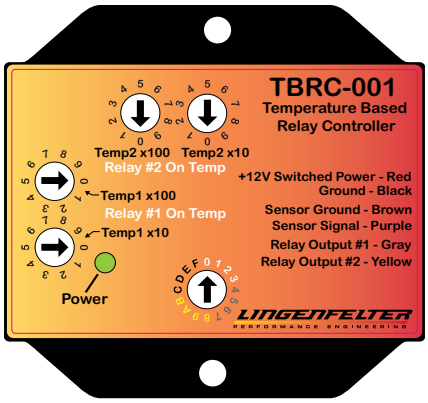
Thank you for purchasing the Lingenfelter Performance Engineering (LPE) TBRC-001 Temperature Based Relay Controller. The TBRC-001 is designed to control two independent relays based on temperature sensor readings. This module can be used to:

- **Independently activate two relays in order to control fans, pumps, or other devices.**
  - **This module is used in the LPE intercooler radiator kits to control the two fans at high and low speeds, and also in the LPE differential cooler kits to control the fan and pump.**
- **Activate intercooler water spray based on air temperature or alcohol injection based on intercooler temperature.**
- **Activate a warning light based on exhaust gas temperature, transmission fluid temperature, oil temperature, or other temperature readings.**
- **These instructions are specifically for the Rev. "B" version of the product that added support for the Bosch ECT and IAT sensors**

Table 1 - Wiring (also labeled on module)

Wire color	Label	Notes
Red	+12V Switched Power	Connects to a switched and fused +12 volt DC source.
Black	Ground	Connects to a vehicle ground.
Brown	Sensor Ground	This wire provides a ground path for the sensor.
Purple	Sensor Signal	This wire connects to the sensor signal output wire.
Gray	Relay Output #1	This wire should be connected to a relay used to control components such as an intercooler radiator fan or differential cooler fan. This output provides normally off ground activation.
Yellow	Relay Output #2	This wire should be connected to a relay used to control components such as an intercooler radiator fan or differential cooler fan. This output provides normally off ground activation. **Use this output for Output Cycling Mode.**

Settings:



- Controlled by four (4) ten position switches, one (1) sixteen position switch, and four (4) DIP switches
- Two (2) ten position switches for selecting the temperature settings for Relay #1
  - Degrees Fahrenheit (in hundreds of degrees)
  - Degrees Fahrenheit (in tens of degrees)
  - Possible temperature range of 10-990 degrees Fahrenheit in 10 degree increments
- Two (2) ten position switches for selecting the temperature settings for Relay #2
  - Degrees Fahrenheit (in hundreds of degrees)
  - Degrees Fahrenheit (in tens of degrees)
  - Possible temperature range of 10-990 degrees Fahrenheit in 10 degree increments
  - For EGT type sensors (sensor settings of 8, 9, A, or B on TBRC-001), 1000 degrees Fahrenheit is added to the selected temperature setting. For an EGT type sensor, the possible temperature range is 1000-1990 degrees Fahrenheit in 10 degree increments.
- One (1) sixteen position switch for selecting the sensor type and activation hysteresis

Table 2 - TBRC-001 Sensor and Hysteresis Settings

Type of sensor	Hysteresis (in F°)				
	5	10	15	25	
OEM GM IAT, ECT	0	1	2	3	Setting on 16 position switch
AEM / Autometer 1/8 NPT	4	5	6	7	
GM / AEM / Bosch / Sensata EGT platinum RTD	8	9	A	B	
Bosch IAT/ECT sensor	C	D	E	F	

- Four (4) DIP switches for activating and controlling **Output Cycling Mode**
  - **Output Cycling Mode** is used in applications where the device that you would like to measure does not have provisions for a temperature sensor. See the **Output Cycling Mode** section of the instructions on page 4 for further explanation of function and settings.
  - DIP switches #1-4 are used to control this setting. DIP switch #5 is inactive and has no effect on the setting. Refer to the rear cover graphic on page 4, which shows the available configurations.
  - Output Cycling Mode is only available for relay output #2.

Status LED:

- Solid RED when powered up with no temperature sensor detected or with no temperature sensor within the range of the accepted values.
  - -35°F to 350°F for IAT or ECT sensors.
  - -35°F to 2500°F for EGT sensors.
- Solid GREEN when the temperature sensor is detected and within the valid temperature range, but the temperature has not reached the user-defined activation point.
- Blinking GREEN when Relay Output #1 is active, but Relay Output #2 is inactive.
- Blinking RED when Relay Output #1 is inactive, but Relay Output #2 is active.
- Blinking GREEN+RED when both Relay Output #1 and Relay Output #2 are active.

Installation:

- Disconnect the negative battery terminal.
- Connect the black wire of the TBRC-001 to a suitable vehicle ground.
- Connect the red wire to a **switched and fused** +12 volt DC source.
- Connect the brown wire to the ground side of the temperature sensor.
- Connect the purple wire to the sensor output signal. This signal will increase or decrease as the temperature measured by the sensor increases, depending on the type of sensor used.
- Connect the gray wire (Relay #1) to the relay that controls your first component (such as a fan or a pump).
- Connect the yellow wire (Relay #2) to the relay that controls your second component.
  - If you are using an EGT type sensor and you want to activate a relay above 1000 degrees Fahrenheit, you must connect it to this wire because relay output #2 is the only output that can be set to above 1000 degrees Fahrenheit.
  - If using Output Cycling Mode, the device to be cycled must be connected to this output.
- Secure the device using the supplied hook and loop tape or using the supplied self tapping screws.
- Set the sixteen position switch to the correct setting for the desired sensor type and hysteresis. Refer to the Table 2 on page 2 in order to select the desired setting.
- If connecting to a relay through the gray wire, set the desired relay #1 ON temperature using the two (2) ten position switches labeled “Temp1 x100” and “Temp1 x10”.
- If connecting to the relay through the yellow wire, set the desired relay #2 ON temperature using the two (2) ten position switches labeled “Temp2 x100” and “Temp2 x10”. If the sixteen position switch (sensor type and hysteresis) was set anywhere from ‘8’ to ‘B’, 1000 degrees Fahrenheit will be added to the selected relay #2 ON temperature.

⚠CAUTION

Additional notes / warnings:

- **Changes to the settings on the TBRC-001 must be done with the ignition off.**
  - The switch positions are only read when the module is initially powered up.
- Do NOT submerge the module in liquid or directly wash the unit with liquid of any type! The switches on the TBRC-001 are sealed but are NOT rated for high pressure washing, use caution if power washing near the TBRC-001 module. Mount the module where it will not be exposed to constant water.
- Do NOT mount the TBRC-001 directly on top of the engine or near the exhaust manifolds due to heat concerns.
- Do NOT mount the TBRC-001 in the line of site of high temperature objects such as exhaust manifolds, turbine housings etc. If needed, put a heat shield in between the heat source and the module to protect the plastic case.
- Do NOT install within 6" of nitrous solenoids or other devices with strong magnetic fields.
- Do NOT install near the spark plugs or the spark plug wires (or other potential strong sources of electrical noise).
- LPE recommends the use of resistor type spark plugs and RFI (radio frequency interference) and EMI (electromagnetic interference) suppression spark plug wires on all EFI engines and any vehicle that has electronic control modules on board (including the TBRC-001). Failure to do so may result in erratic operation of electronic devices including the TBRC-001.
- Do NOT install the TBRC-001 to a sensor that is already being used by another device. This will cause the TBRC-001 and the other device to inaccurately read the temperature.

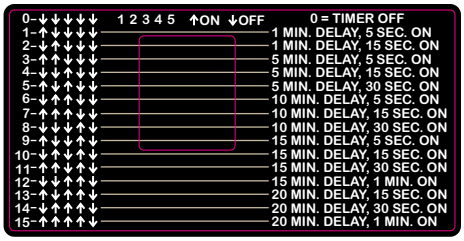
Output Cycling Mode

If it is desired to measure the temperature inside a device that does not have provisions for a temperature sensor, the only solution may be to put the temperature sensor inline with the device. If the temperature sensor must be installed in the fluid lines connected to the device, the TBRC-001's Output Cycling Mode can be used to circulate hot fluid past the sensor (i .e. you want to cycle the pump to get the hot fluid out of the differential or transmission and past the sensor so you can determine the temperature of the fluid in the differential or transmission). While in Output Cycling Mode, several cycle rate and duration settings are available.

To change cycle rate and duration settings:

- Use a #1 Phillips head screwdriver to remove the back cover of the unit.
- On the inside of the unit's back cover, there is a sticker that shows the possible cycle rate and duration settings, as well as the correct DIP switch configuration for each one. This graphic is shown on the right.

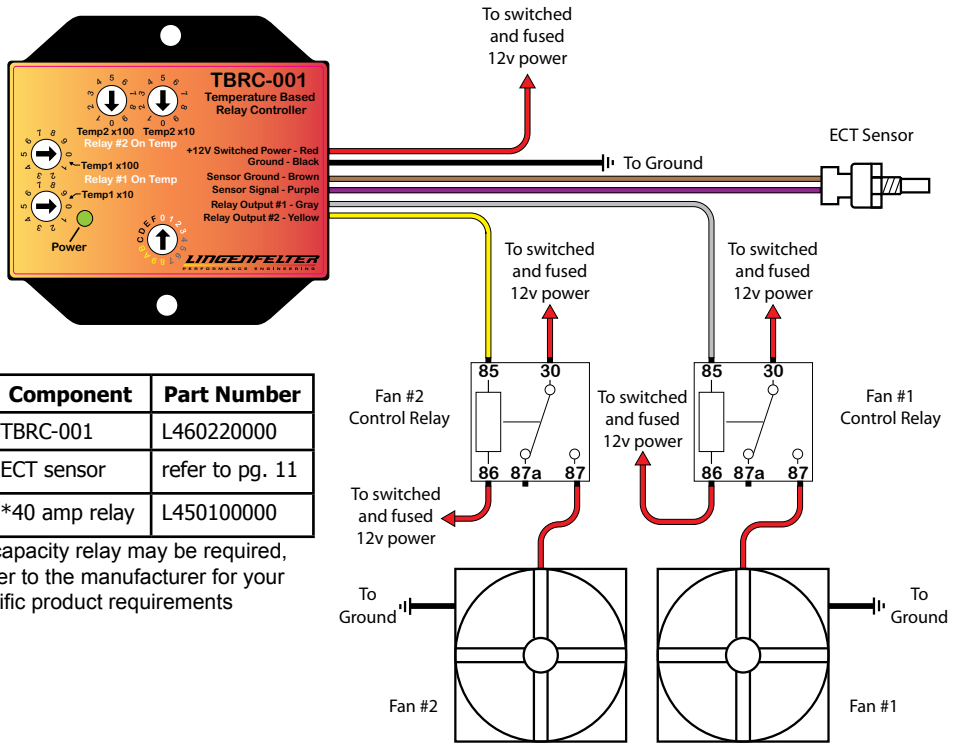
Figure 2: DIP switch settings



(This graphic can also be found under the back cover of the TBRC-001)

- Using a small flat head screwdriver, flip the correct DIP switches ON or OFF to select the desired cycle rate and duration.
  - Setting examples:
    - To deactivate Output Cycling Mode, set the DIP switches to setting #0 (↓↓↓↓↓)
    - In order to activate output #2 for 15 seconds every 5 minutes, set the DIP switches to setting #4 (↓↓↑↓↓).
    - **In order to activate output #2 for 30 seconds every 10 minutes, set the DIP switches to setting #8 (↓↓↓↑↓).**
    - **In order to activate output #2 for 1 minute every 15 minutes, set the DIP switches to setting #12 (↓↓↑↑↓).**
- Replace and secure the rear cover plate to the back of the TBRC-001.
- Power up the device to finalize the changes to the cycle rate and duration.

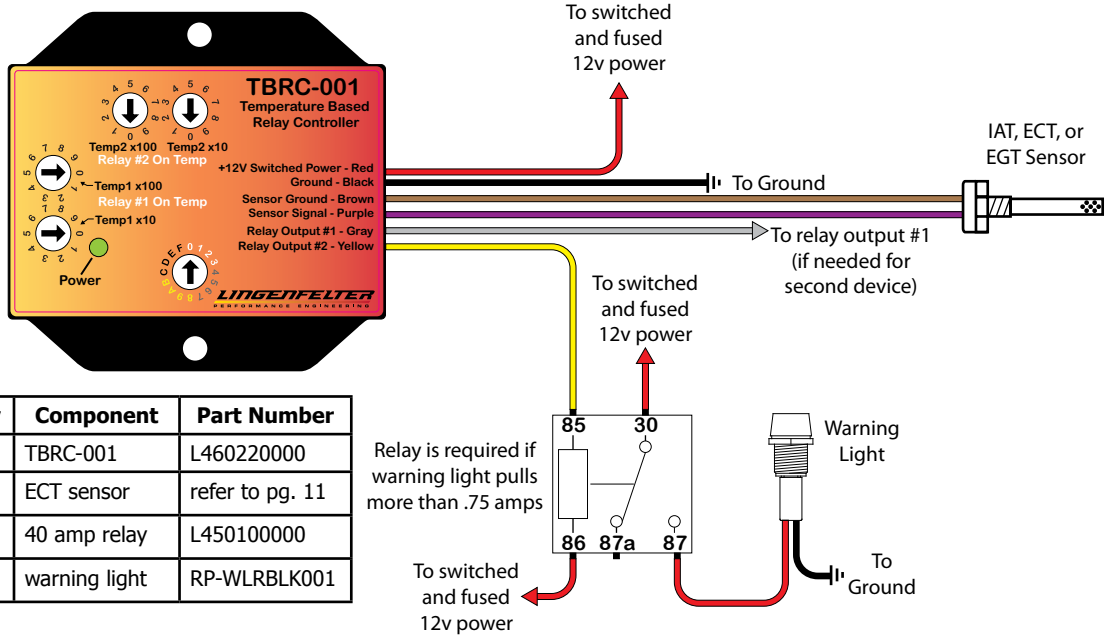
Using the TBRC-001 to activate two independent fans based on ECT sensor output



Quantity	Component	Part Number
1	TBRC-001	L460220000
1	ECT sensor	refer to pg. 11
2	*40 amp relay	L450100000

*a higher capacity relay may be required, please refer to the manufacturer for your specific product requirements

Using the TBRC-001 to activate a warning light based on IAT, EGT, or ECT sensor output

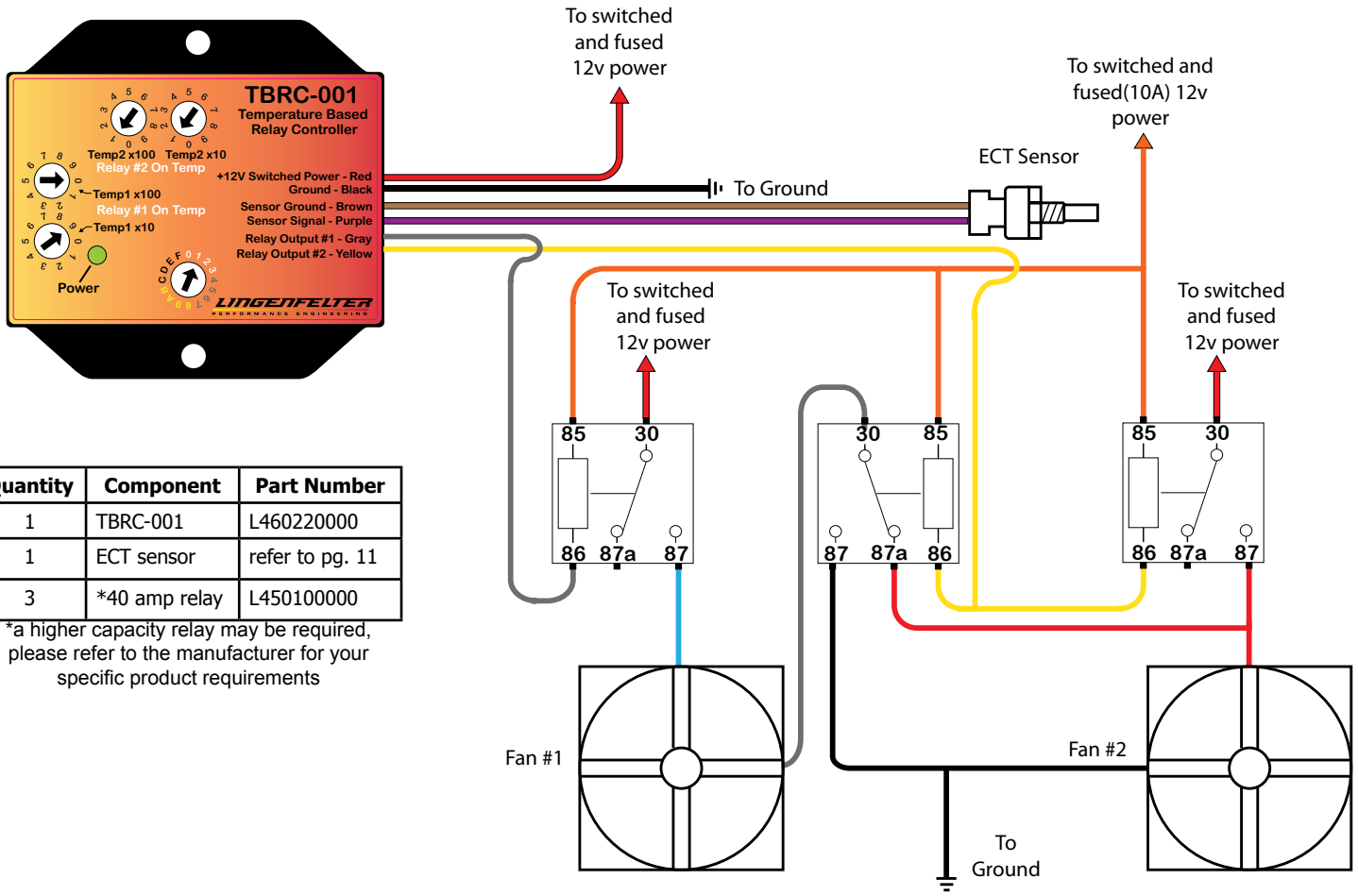


Quantity	Component	Part Number
1	TBRC-001	L460220000
1	ECT sensor	refer to pg. 11
1	40 amp relay	L450100000
1	warning light	RP-WLRBLK001

Using the TBRC-001 to activate two fans at two speeds (LOW or HIGH) based on ECT sensor output

The fans that operate at two speeds run from parallel to series. This causes a variation in voltage supplied to the fans. In this case, the voltage that goes to the fans is either 6V or 12V. Some fans may not operate well at 6V. Verify that the fan(s) you are using are able to operate at 6V from the fan manufacturer. The settings for the next five examples are as follows: Temp1 is set to 90 degrees; Temp2 is set to 100 degrees; and 10 degrees is set for the hysteresis for a OEM GM type sensor.

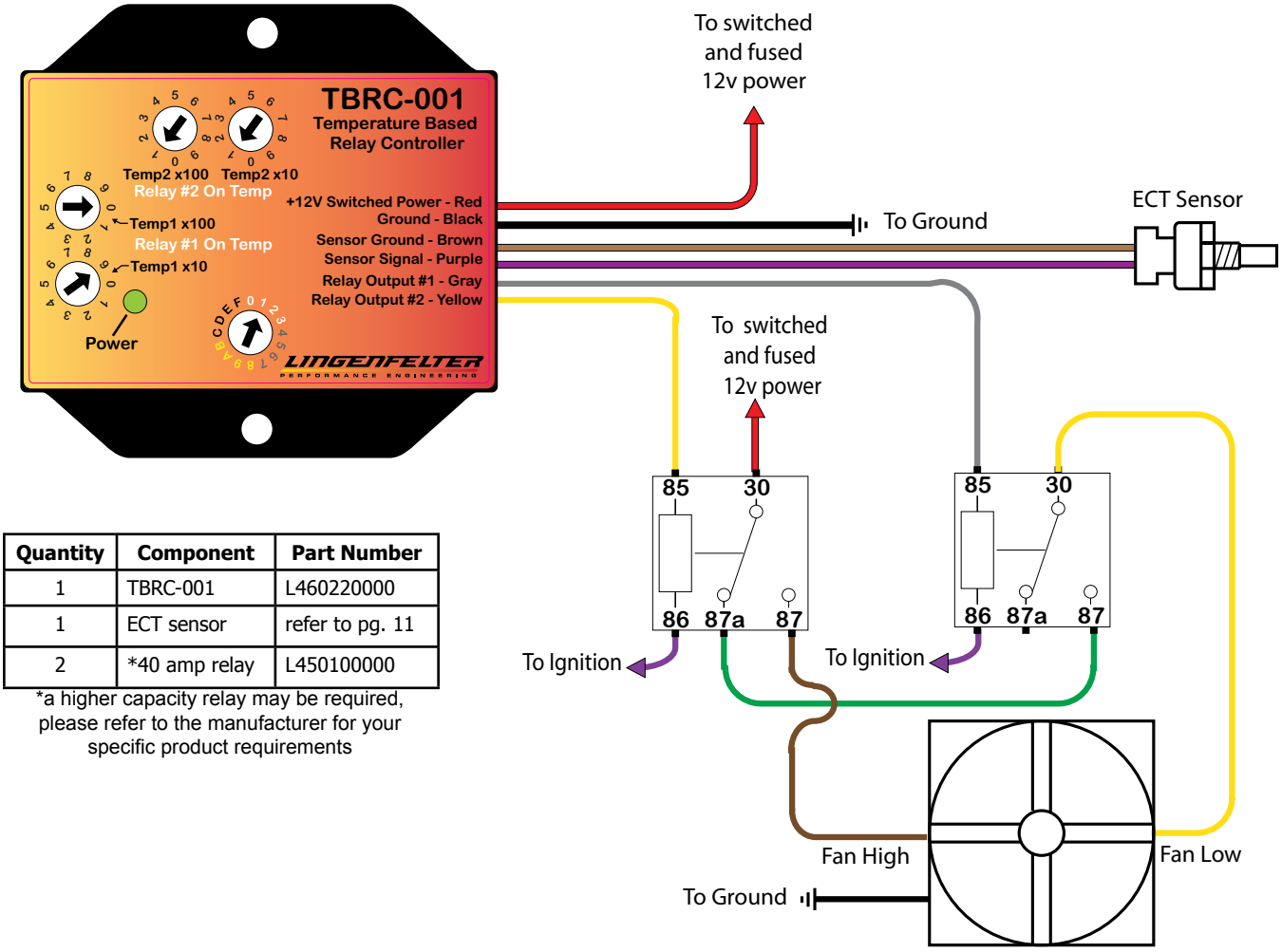
- As the temperature warms up, the fan(s) turn(s) on low speed at 90 degrees F.
- The fan(s) turn(s) on high speed at 110 degrees F.
- As the temperature cools the fan(s) should go back to low speed at 100 degrees F.
- The fan(s) should turn back off at 80 degrees F.



Quantity	Component	Part Number
1	TBRC-001	L460220000
1	ECT sensor	refer to pg. 11
3	*40 amp relay	L450100000

*a higher capacity relay may be required, please refer to the manufacturer for your specific product requirements

Using the TBRC-001 to activate a two speed fan based on ECT sensor output

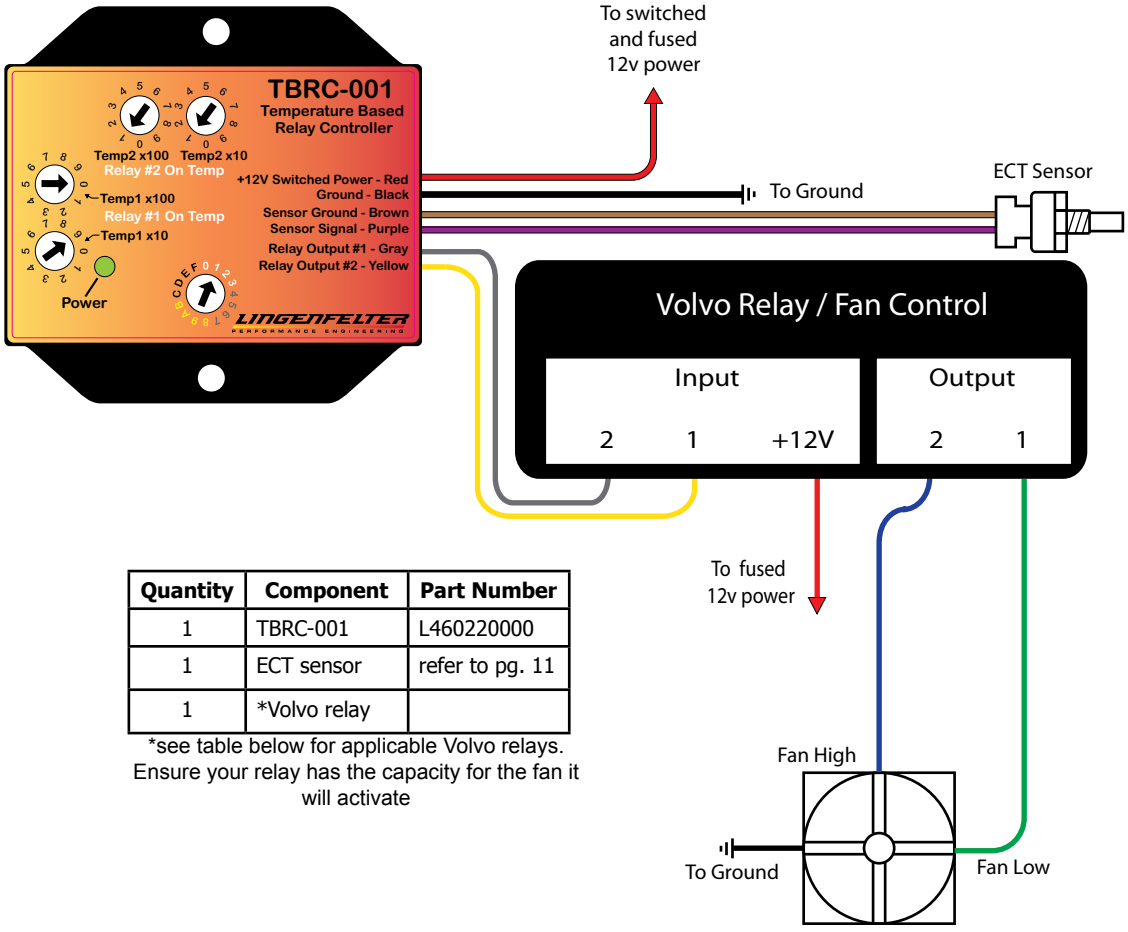


Quantity	Component	Part Number
1	TBRC-001	L460220000
1	ECT sensor	refer to pg. 11
2	*40 amp relay	L450100000

*a higher capacity relay may be required, please refer to the manufacturer for your specific product requirements

CAUTION

Using the TBRC-001 in conjunction with a Volvo or similar cooling fan relay to activate a two speed fan based on ECT sensor output



Quantity	Component	Part Number
1	TBRC-001	L460220000
1	ECT sensor	refer to pg. 11
1	*Volvo relay	

*see table below for applicable Volvo relays. Ensure your relay has the capacity for the fan it will activate

The following Volvo OEM parts for the Volvo Cooling Fan Relay 2-SPD:

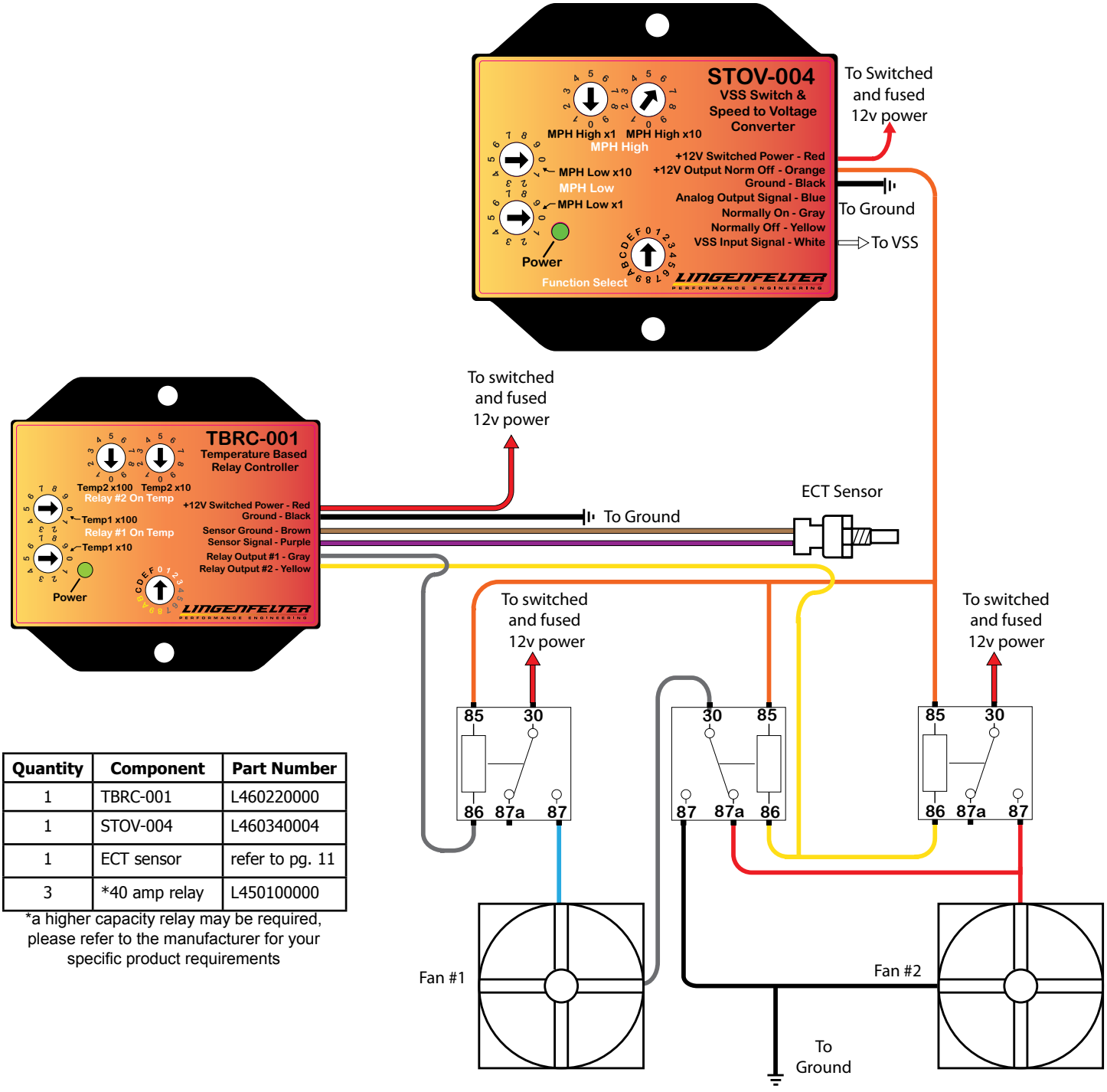
Volvo OE: 9442933, 1398845, 3523872.

Kaehler also manufactures a part that is similiar to the Volvo Cooling Fan Relay. The part number is KAE 3702300.

The “Volvo” name is property of the Volvo Car Corporation

Using the TBRC-001 and STOV-004 to activate two fans at two fan speeds (LOW or HIGH) based on ECT and VSS sensor output

Using the wiring diagram below, the fans are based on temperature as well as the speed of the vehicle. The STOV-004 in this diagram utilizes the +12V Output Normally ON function. What this does is switch the +12V Output Normally OFF to Normally ON, switch the ground output that is Normally OFF to Normally ON, and switch the ground output that is Normally ON to Normally OFF. To set the +12V output to be normally on, set both of the MPH Low rotary switches to 0 and then set the desired switch point speed using the MPH High rotary switches. The x1 switch controls the speed setting in 1 MPH increments and the x10 switch controls the speed setting in 10 MPH increments. In this example, the STOV-004 in the diagram is set to 60 MPH on MPH High. This means that if the MPH of the vehicle exceeds 60 MPH the fans will not be active regardless of what the temperature reading is.



Quantity	Component	Part Number
1	TBRC-001	L460220000
1	STOV-004	L460340004
1	ECT sensor	refer to pg. 11
3	*40 amp relay	L450100000

*a higher capacity relay may be required, please refer to the manufacturer for your specific product requirements

Table 3: Temperature Sensor Resistance vs. Temperature

Temperature		Temperature sensor type (settings group on TBRC-001)			
		GM ECT/IAT/TFT (use settings 0-3)	AEM / Autometer 1/8 NPT (use settings 4-7)	GM / AEM / Bosch / Sensata EGT Platinum RTD (use settings 8-B)	Bosch IAT/ECT Sensor Group (settings C-F)
°C	°F	Resistance values measured in Ohms			
-40	-40	100700	402000	170	45,313
-30	-22	52700	210000	178	26114
-20	-4	28680	114000	185	15462
-10	14	16180	64300	193	9397
0	32	9420	37500	201	5896
10	50	5670	22500	208	3792
20	68	3520	14000	216	2500
30	86	2238	8900	224	1707
40	104	1459	5800	231	1175
50	122	973	3900	239	834
60	140	667	2700	246	596
70	158	467	1900	254	436
80	176	332	1300	261	323
90	194	241	965	268	243
100	212	177	710	276	187
110	230	132	531	284	144
120	248	100	403	291	113
130	266	77	309	299	89
140	284	60	241	306	71
150	302	47	189	313	57
200	392	-	-	349	-
300	572	-	-	420	-
400	752	-	-	488	-
500	932	-	-	554	-
600	1112	-	-	618	-
700	1292	-	-	679	-
800	1472	-	-	738	-
900	1652	-	-	795	-
1000	1832	-	-	849	-

- All resistance values shown above are approximate and will be different based on which specific temperature sensor you use. Also keep in mind that most of these sensors are rated to within +/- 3% to 5% variation from sensor to sensor so the above tables are not exact.

Table 4: Common Bosch IAT, ECT & Other Fluid Temperature Sensors

Description	Bosch PN	Alternate PN	Thread Size	Mating Connector	Terminals	GM Service Harness	AC Delco Service Harness
Differential Temp. Sensor	20837545	N/A	M12 x 1.5	15449028	15326266	88987993	PT1798
Differential Oil Cooler Temp. Sensor	20907436	N/A	M12 x 1.5				
Manual TFT Sensor	12458118	N/A	M21 x 1.75	15449028	15326266	88987993	PT1798
ECT Sensor	12608814	213-4333	M12 x 1.5	15449028	15326266	88987993	PT1798
IAT Sensor, fast response	12614717	213-4405	M14 x 1.5 taper pipe	12162197	12089290	12102620	PT307
IAT Sensor, fast response	12160244	213-243	Press-in 14 mm	12162197	12089290	12102620	PT307
Ambient Air Temp. Sensor	15936931	213-4190	Press-in	12052641	12048074	12101856	PT248
EGT Sensor	12636612	213-4695	M14 x 1.5	13510099	15326268	88987860	PT1703
ECT Sensor	12146312	213-928	3/8” - 18 NPTF	15449028	15326266	88987993	PT1798
ECT Sensor	15326388	213-953	M12 x 1.5	15449028	15326266	88987993	PT1798
ECT Sensor	1795138	N/A		15449028	15326266	88987993	PT1798
ECT Sensor	1924495	N/A		15449028	15326266	88987993	PT1798
IAT Sensor	12110446	N/A	3/8” - 18 NPTF	12162197	12089290	12102620	PT307
IAT Sensor	12146830	N/A	3/8” - 18 NPTF	12162197	12089290	12102620	PT307
IAT Sensor, fast response	25036751	213-190	3/8” - 18 NPTF	12162197	12089290	12102620	PT307
IAT Sensor, fast response	25037225	213-190	3/8” - 18 NPTF	12162197	12089290	12102620	PT307
IAT Sensor, fast response	25037034	213-190	3/8” - 18 NPTF	12162197	12089290	12102620	PT307
Bosch Sensor	2782569739	N/A	M12x1.5	D 261 205 288-01	N/A	N/A	N/A
Bosch Sensor	2782650379	N/A	M12x1.5	D 261 205 288-01	N/A	N/A	N/A
Bosch Sensor	2782610059	N/A	M12x1.5	D 261 205 288-01	N/A	N/A	N/A
Bosch Sensor	2782412811	N/A	M6x1	F 02U 000 231-01	N/A	N/A	N/A
Bosch Sensor	2782334347	N/A	M6x1	F 02U 000 231-01	N/A	N/A	N/A
Bosch Sensor	0280130039	N/A	M12x1/5	D 261 205 288-01	N/A	N/A	N/A

Troubleshooting

If you believe that the TBRC-001 is switching at an incorrect temperature, check the following:

- Use a multimeter to measure the sensor's resistance at a certain temperature. Compare the measured resistance to the resistance values on the sensor type vs. sensor resistance chart on page 11.
- Check to verify that you have set the 16 position (sensor type and hysteresis) switch to the correct range for your sensor type.
- Make sure no other device is connected to the temperature sensor you are using

NOTICES:

It is the responsibility of the purchaser to follow all guidelines and safety procedures supplied with this product and any other manufacturer's product used with this product.

Lingenfelter Performance Engineering assumes no responsibility for damages resulting from accident, improper installation, misuse, abuse, improper operation, lack of reasonable care, or all previously stated reasons due to incompatibility with other manufacturer's products.

Lingenfelter Performance Engineering assumes no responsibility or liability for damages incurred from the use of products manufactured or sold by Lingenfelter Performance Engineering on vehicles used for competition racing.

It is the purchaser's responsibility to check the state and local laws and sanctioning body requirements pertaining to the use of this product for racing applications. Lingenfelter Performance Engineering does not recommend nor condone the use of its products for illegal street racing.

Limited Warranty:

LPE warrants the Lingenfelter TBRC-001 Temperature Based Relay Controller to be free from defects in material and workmanship under normal use and if properly installed for a period of 1 year from date of purchase. If the module is found to be defective as mentioned above, it will be replaced or repaired if returned prepaid along with proof of date of purchase. This shall constitute the sole remedy of the purchaser and the sole liability of LPE. To the extent permitted by law, the foregoing is exclusive and in lieu of all other warranties or representations whether expressed or implied, including any implied warranty of merchantability or fitness. In no event shall LPE be liable for special or consequential damages.

For additional product installation information and technical support, contact LPE or your LPE products distributor. You can also find technical support and usage discussions regarding this product and many other LPE products in our Internet forums:

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