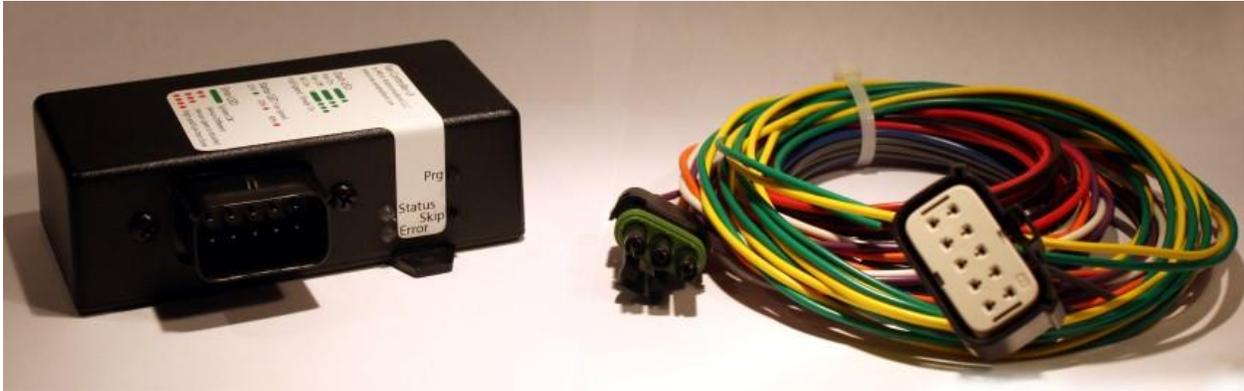


Fan Controller v3

Micro Automations LLC

www.ma-embedded.com

© 2014



Description

This controller was designed to control C-Class fans from Mercedes. It will work with any standalone temperature sensor, or it may piggyback on any 5v EFI temperature sensor. Use, described in more detail later, entails entering programming mode to set the turn on and 75% fan speed temperatures. The controller will command the fan speed linearly between and above those two temperature set points.

As a safety feature, if the controller does not detect a temperature sensor, it will turn the fan on; or, if the active sensor wire gets grounded, it will turn the fan on.

Contents

List of Figures	2
Revision History	2
Theory of Operation.....	3
Maximum Voltage Specifications.....	4
Pin Diagram.....	4
Signal Descriptions.....	5
Onboard status LEDs.....	7
Wiring Diagrams – One Terminal Sensor	8
Wiring Diagrams – Two Terminal Sensor	9
Wiring Diagrams – EFI Sensor	10
Wiring the Fan.....	11
Recommended sensors.....	11
Compatibility.....	12
Programming the controller	13
Error Modes	16
Troubleshooting.....	17
Mounting the controller	18
Warranty	19

List of Figures

Figure 1 – Fan speed vs. Engine Temperature	3
Figure 2 - Pin Diagram.....	4
Figure 3 - Installing the Remote Status LED to operate either Red or Green.....	7
Figure 4 - Wiring with a one terminal temperature sensor installed	8
Figure 5 - Wiring with a two terminal temperature sensor installed	9
Figure 6 - Wiring using a 0-5v EFI temperature sensor.....	10
Figure 7 - Fan plug wiring.....	11
Figure 8 - Programming Flowchart	13
Figure 9 - Controller mounting dimensions	18

Theory of Operation

The v3 controller has been designed to work in a variety of different systems. It can work with any standalone temperature sensor, or it may piggyback off any 0-5v EFI temperature sensor. The controller is able to detect and operate properly with both positive and negative going temperature sensors. During programming, the controller detects whether the EFI or standalone temperature sensor input is active. The controller is then able to use this information to aid in detecting various error modes.

During normal operation, the controller reads the current temperature at a rate of once every 2.5 seconds. It then checks several different factors in determining whether to turn the fan on or off, or what speed to command the fan to operate at. The fan can operate at any speed between 25% and 90%. At initial turn on, the fan will operate at 50% very briefly, then return to the normally commanded speed.

After programming, the controller contains two temperature points: the turn on temperature, where the fan will turn on to 25% speed, and the 75% temperature, where the fan will operate at 75% speed.

In the figure below, the controller has been programmed with pre-set temperature range #1, with a turn on temperature of 170°F, and a 75% temperature of 185°F. As the engine temperature rises and reaches the turn on point, the fan will turn on to 25%. As the engine temperature continues to rise, fan speed will increase linearly until it reaches 75% speed at 185°. If the engine temperature still continues to rise, fan speed will continue to increase until it reaches its full speed of 90% at 190°.

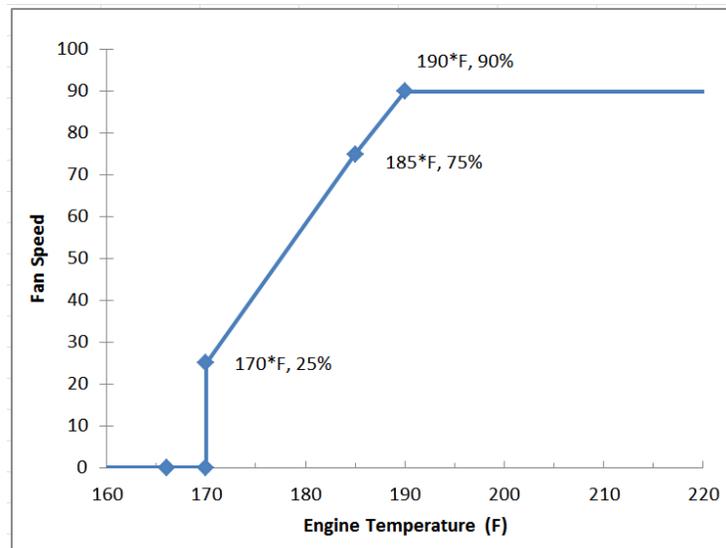


Figure 1 – Fan speed vs. Engine Temperature

As the engine temperature decreases, fan speed will also decrease, eventually reaching the 25% turn on temperature. If the engine temperature continues to decrease below the turn on temperature, it will maintain 25% fan speed until the engine temperature has dropped approximately 3-5°F below the turn on temperature. Once the engine temperature is below this hysteresis point, the fan will turn off and await the call to turn on again.

Maximum Voltage Specifications

Maximum input voltage: 18v DC

Maximum voltage on AC input pin: 18v

Maximum voltage on pins 4 and 5: 5v

Do not apply external voltage to any pins other than 1, 3, 4, and 5.

We recommend using 18awg wire to install the controller. Nothing larger is necessary.

Pin Diagram

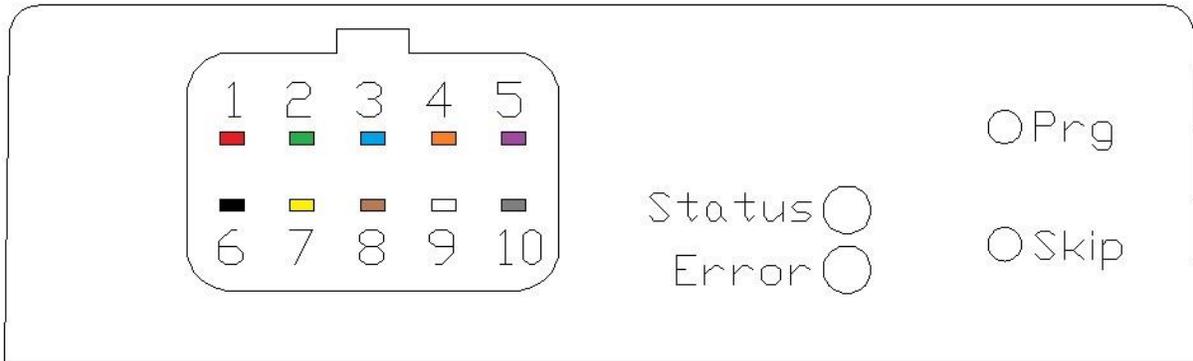


Figure 2 - Pin Diagram

Name	Color	Pin Number
Switched 12v Input	Red	1
Trigger Output	Green	2
Air Conditioning Input	Blue	3
Standalone Temperature Sensor (+)	Orange	4
EFI Temperature Sensor	Purple	5
Ground	Black	6
Speed Output	Yellow	7
Output to Mopar dash temperature gauge	Brown	8
Standalone Temperature Sensor Return (GND)	White	9
Remote Status LED	Gray	10

Signal Descriptions

Switched 12v – Red - 1

Main power input to the controller. This must be from a switched source so the controller is off when the vehicle is off and during cranking. A 5 amp inline fuse is recommended.

Ground – Black - 6

Main ground for the controller. This must have a good connection to ground. This should be wired such that it is near the main ground point near the battery. The engine ground strap, and the ground for the fan, should also be located in the same spot.

Note:

Power and Ground to the fan are separate from the controller power and ground, and should include an inline 50A fuse/breaker minimum
--

Trigger Output – Green - 2

This is the On/Off signal to the Mercedes Fan. Do not apply any external voltage or ground to this pin. Do not reverse this wire with the Speed wire. This signal is required for the fan to operate.

Speed Output – Yellow - 7

This is the variable duty cycle speed signal to the Mercedes Fan. Do not apply any external voltage or ground to this pin. Do not reverse this wire with the Trigger wire. This signal is required for the fan to operate.

Air Conditioning Input – Blue - 3

This input indicates that the air conditioning (AC) system is operating, and that the fan should be turned on. This pin may be either grounded, or tied to +12v by the air conditioning system, typically through the trinary switch. This may also be controlled by a switch to manually turn the fan on. There is a 5 second delay after this signal is active before the fan turns on, and another 5 second delay before it is turned off. When activated, the fan will operate at 50%. If the engine temperature requires it, fan speed will automatically increase above 50%.

Note:

This input is optional, and may be left unused.

Standalone Temperature Sensor (+) – Orange - 4

Two Terminal Temperature Sensor – Either terminal may go on this pin. The other terminal should go to Standalone Temperature Sensor Return (GND).

Single Terminal Temperature Sensor – The one terminal must go to this pin. The body of the sensor must have a good connection to ground.

Note:

Use this input only if there are no other EFI/gauge connections to the temperature sensor. Connecting this input to an EFI/gauge signal could change the temperature reported to the EFI system, causing significant issues.

Standalone Temperature Sensor Return (GND) – White - 9

This pin is internally connected to ground. When using a two terminal temperature sensor, connect one terminal to this pin. Leave this pin unused when using a single terminal temperature sensor.

EFI Temperature Sensor – Purple - 5

This input may be connected to a temperature sensor connected to an EFI computer system. Its input range is 0v-5v. Some aftermarket temperature gauges may use a 0-12v signal – verify this before splicing this wire into the temperature sensor wire. Both positive or negative going sensors may be used with the controller.

Note:

Use this input if you are piggybacking on the temperature sensor used by MegaSquirt, or any other EFI system, even if it uses the standard GM sensor

Note:

When using this input, you may need to ground the controller at the same point as your ECU to avoid ground loop issues.

Mopar Dash Temperature Gauge – Brown – 8

In stock Mopars, the dash temperature gauge was connected directly to the temperature sensor in the manifold. The Fan Controller cannot piggyback on that signal, and some manifolds only have one open port for a new temperature sensor. This feature was developed to allow the controller to move the needle in the stock dash temperature gauge, while using the only open port with an Autometer #2258.

Connect this output to the old wire that went to the temperature sensor in the manifold.

Remote Status LED – Gray - 10

This output may drive the included LED which can be mounted remotely within view of the driver. The LED is dual color, but only one color may be chosen during installation. Install the Red wire from the LED to this pin for a Red color, and the other wire to ground. Or, reverse the colors for a Green status light. The LED requires a ¼" hole to mount in, and has 6" long tinned wires.

The controller is designed to drive an LED with a forward voltage of 2v-2.2v, while supplying 12mA. Any other suitable LED may be used if desired to match existing indicator lights on the dash. Contact me to verify that your LED will work if you have any questions.

Mode	Action
Vehicle start	After doing a self-check, if no errors found, the Remote Status LED will be solid for 5 seconds
Fan turns On	When the fan turns on, the Remote Status LED will be solid for 5 seconds, then blink once
Fan turns Off	When the fan turns off, the Remote Status LED will be solid for 5 seconds, then blink twice
Air Cond. is activated	When the fan is activated by the air conditioning signal, the Remote Status LED will be solid for 5 seconds, then blink three times
Error	If there is an error, the Remote Status LED will blink in a pattern of 2, 3, or 4 blinks. See the 'Error Mode' section for explanation of each code.
Fan at full speed	If the temperature requires the fan to operate at full speed, the Remote Status LED will turn on steady until the fan speed drops below full speed

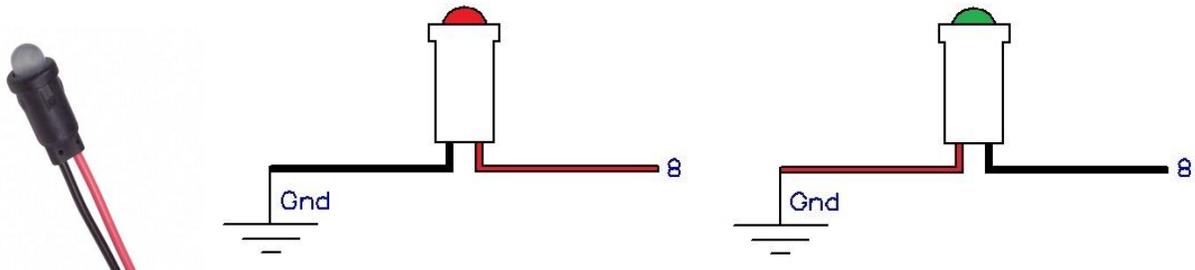


Figure 3 - Installing the Remote Status LED to operate either Red or Green

Onboard status LEDs

There are two LEDs that show the current operating status of the controller.

Mode	Status LED	Error LED
Operating normally, fan off	Off	Green
Fan on	Green->Orange->Red gradient, depending on fan speed Green = 25%, Orange = 50%, Red = 90% (full speed)	Green
Error	Red	Blinking error code
Programming	See programming guide	

Wiring Diagrams - One Terminal Sensor

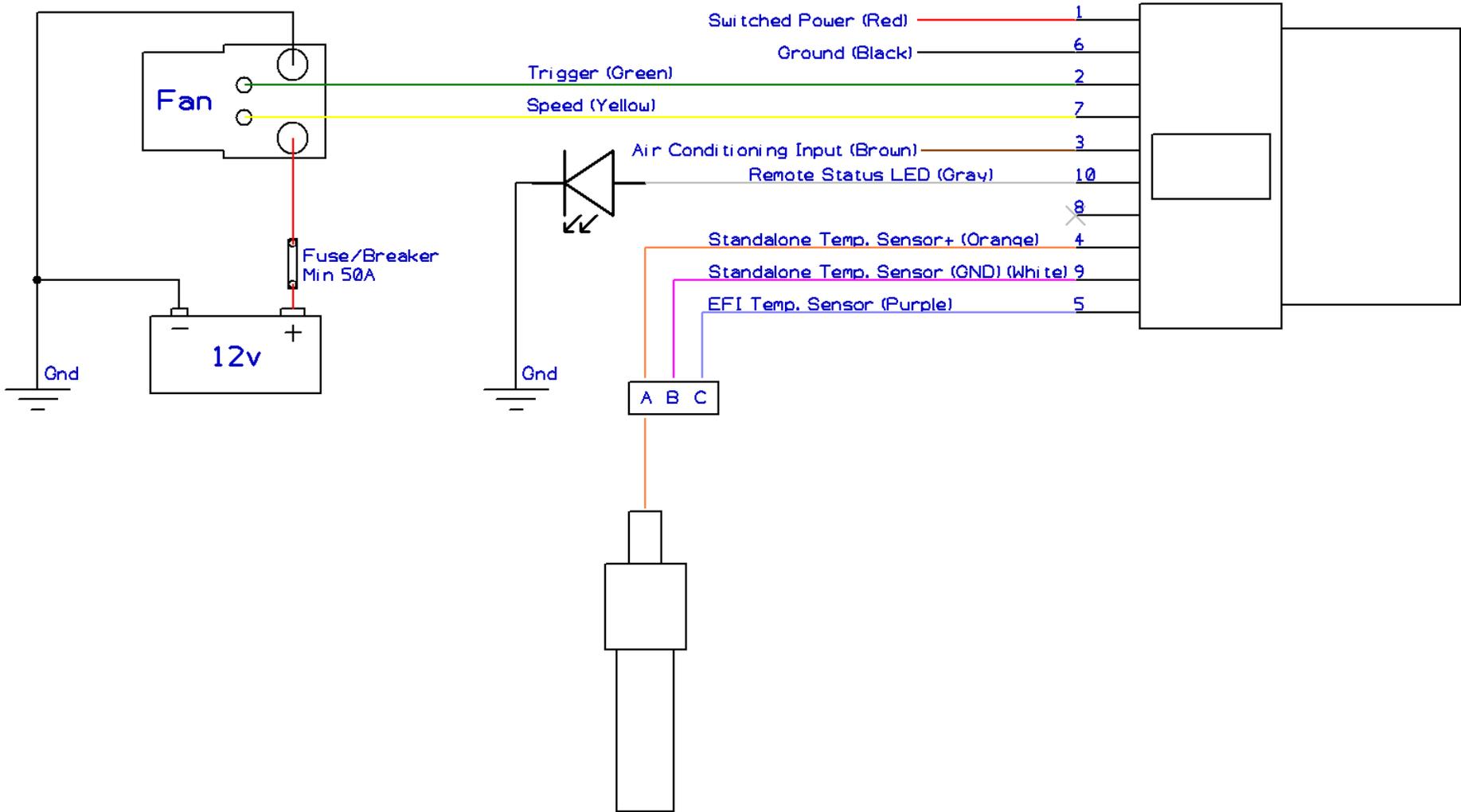


Figure 4 - Wiring with a one terminal temperature sensor installed

Note: When using this configuration, the controller may need to be grounded to the engine block

Wiring Diagrams - Two Terminal Sensor

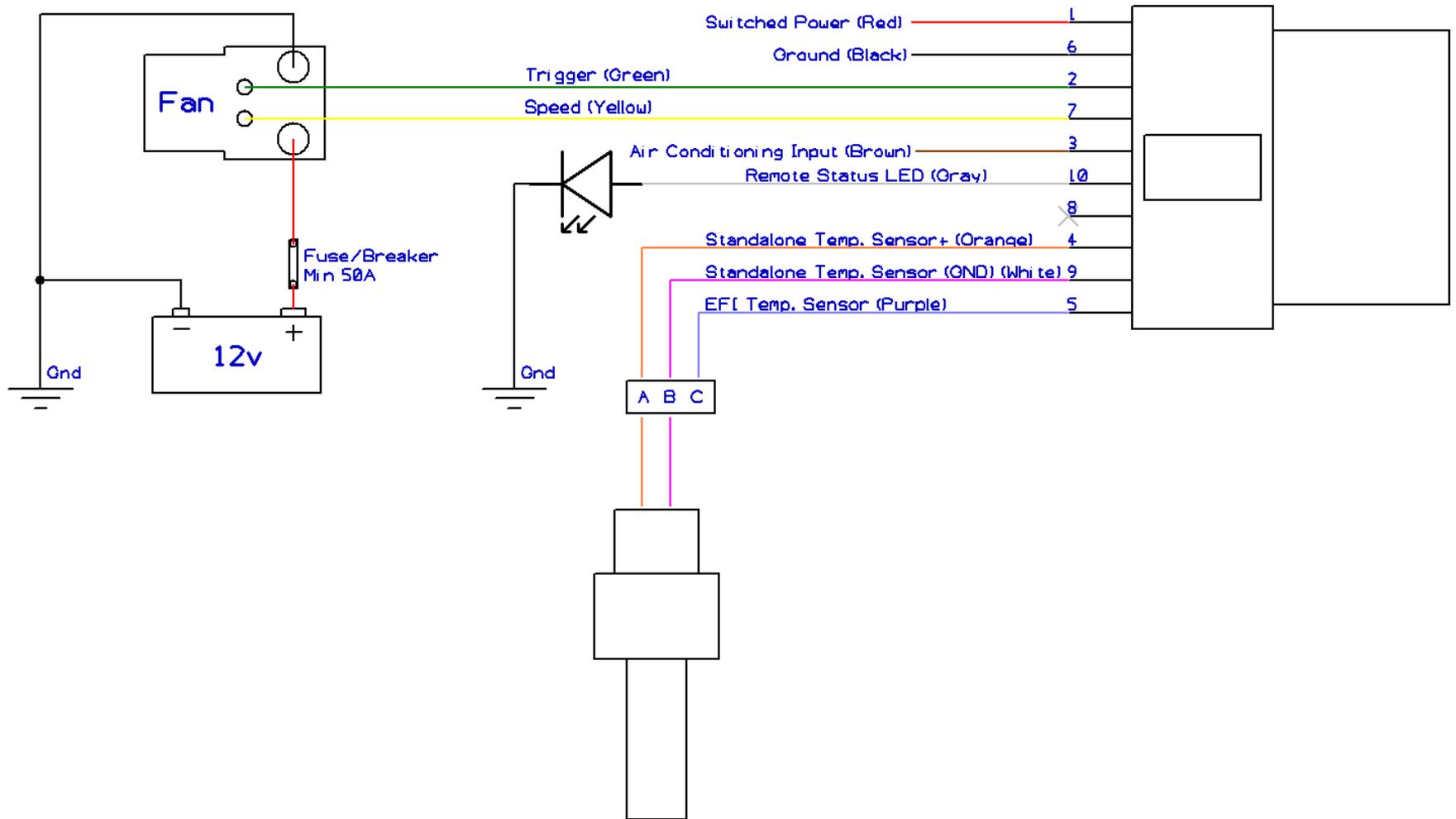


Figure 5 - Wiring with a two terminal temperature sensor installed

Note: When using this configuration, the controller may be grounded anywhere

Wiring Diagrams - EFI Sensor

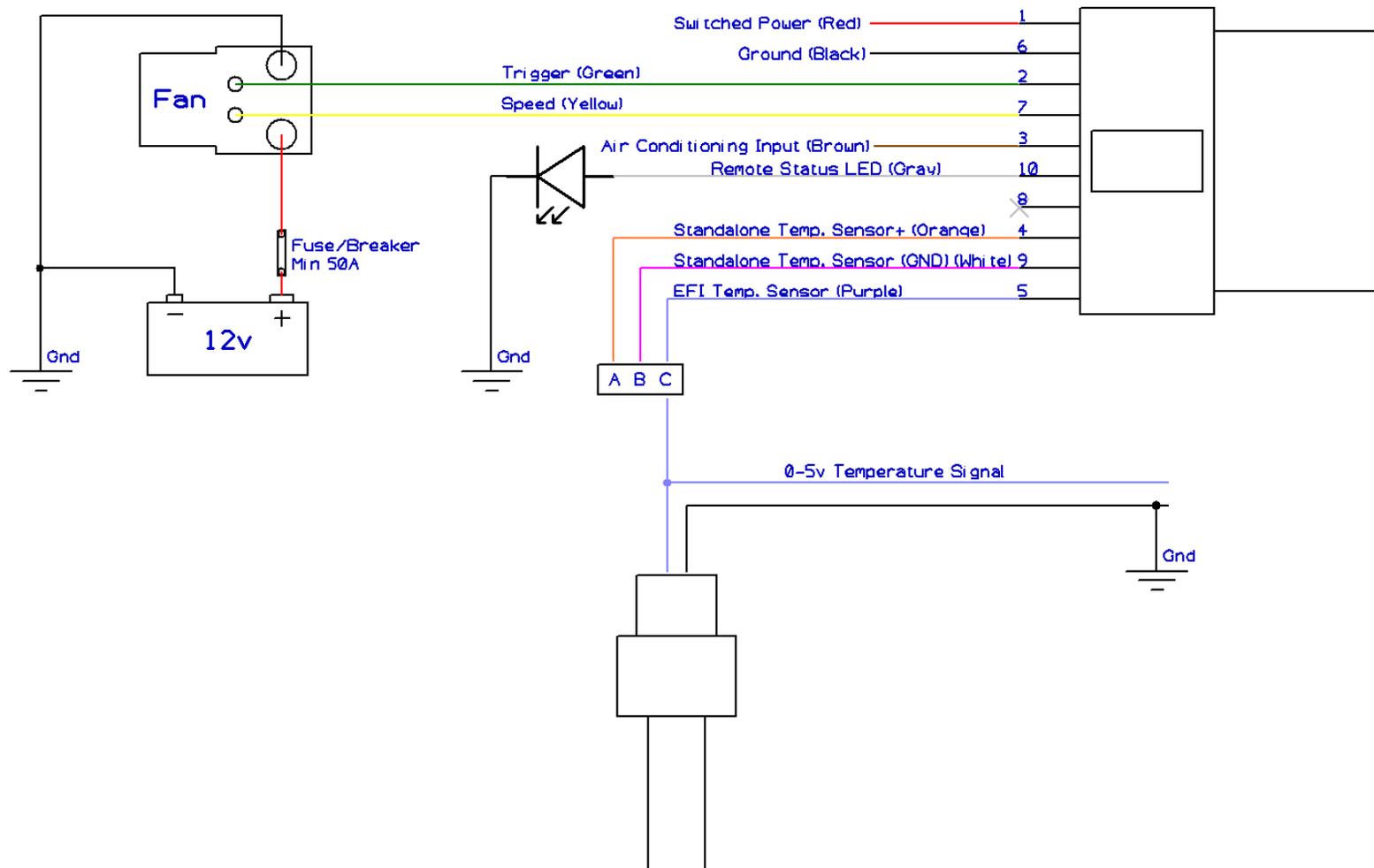


Figure 6 - Wiring using a 0-5v EFI temperature sensor

Note: When using this configuration, the controller MUST be grounded to the same point as the ECU – not under the dash or directly to the battery, but to the same point as the ECU.

Wiring the Fan

The picture below shows the wiring of the fan plug. Power to the fan should be supplied through a 50A minimum fuse/breaker, connected directly to a main power distribution point. Ensure that the power to the fan from the alternator **does not** pass through the bulkhead connector in a stock fashion.

The ground wire must also have a good connection to ground, preferably near the battery.

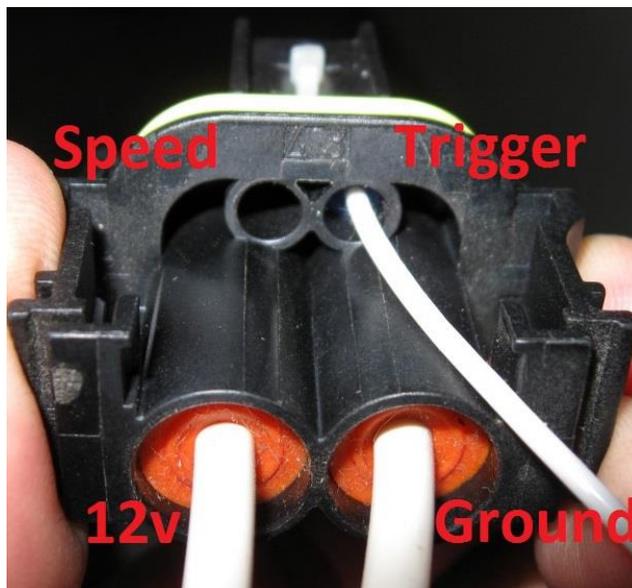


Figure 7 - Fan plug wiring

Part numbers for the fan plug:

Description	Part Number	Quantity Required
Pin Housing/Bushing	220 545 03 29	1
Large Wire	000 540 36 05	2
Small Wire	000 540 38 05	2

Recommended sensors

Any generic GM type temperature sensor should work with the Controller. We have currently tested with a TX3T two terminal temperature sensor. The associated pigtail for this sensor is Pico 5615PT. This sensor has a 3/8" NPT thread.

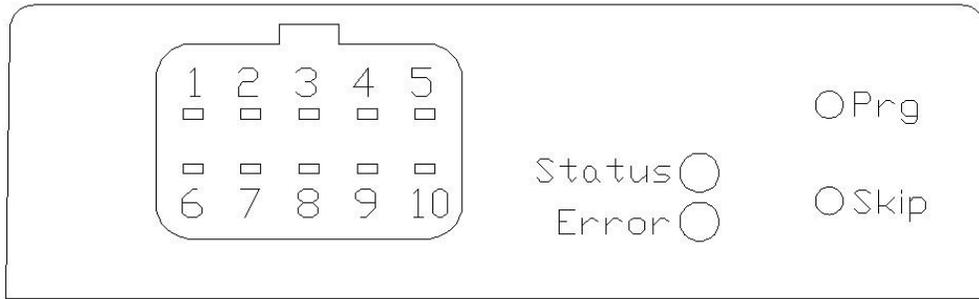
Autometer #2258. This is a single terminal 1/8" NPT sensor. The sensor body must have a good connection to ground. You may not be able to use sealant on the threads.

Compatibility

Fan Controller v3 is known to work with the following fans/vehicles

Fan/Vehicle	Notes
<p>2001 to 2007 C-Class Mercedes</p> <p>SLK32 AMG Fan (Or Module pictured below)</p> 	<p>600W, 800W</p> <p>Speed (yellow) to PWM terminal, Trigger (Green) to '15'. 100k pull-ups on old control lines to avoid CEL</p>

Programming the controller



During programming, the fan will turn off to allow the engine to warm up faster. Press and hold **Prg** until the Status LED lights with the color of the sub-menu you wish to enter, then release **Prg**. Holding **Skip** for 4 seconds will exit any programming menu and return the controller to normal operation. Details about each programming sub-menu can be found on the next page. The Status and Error LEDs will change colors to indicate the current location in the programming flowchart.

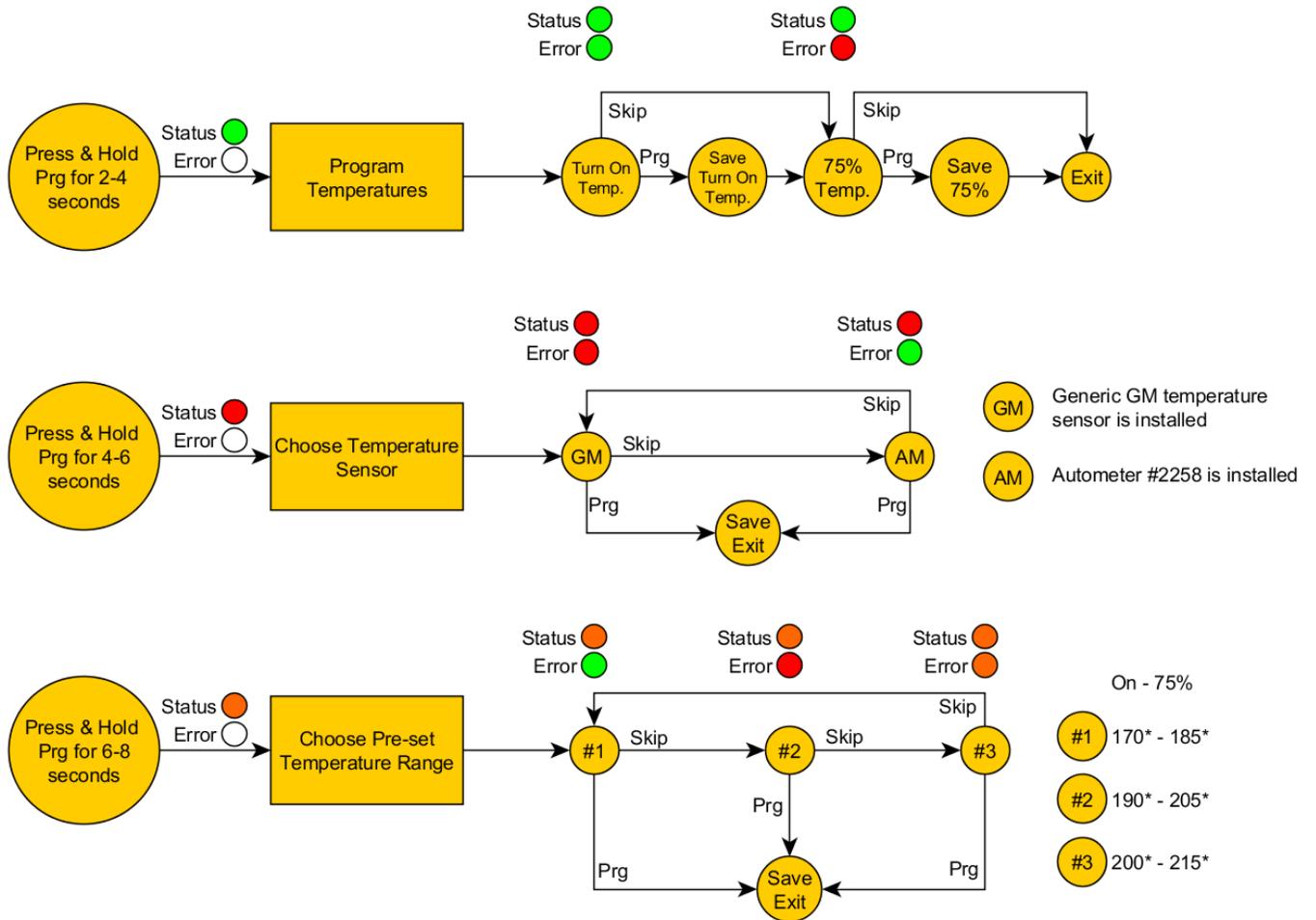


Figure 8 - Programming Flowchart

Program Temperatures:

This mode allows the turn on temperature and 75% speed temperature points to be programmed. Alternatively, the turn on or the 75% points may be programmed independently of each other, by skipping one, and saving the other. The full speed temperature is then automatically calculated from the turn on and 75% temperature points, whenever they are changed.

The controller will automatically detect whether the EFI or standalone temperature sensor is active. When piggybacking on an EFI sensor, this is the only mode that should be used.

Note:
Choosing a sensor or selecting a pre-set range is disabled when the controller detects that the EFI input is active

Use:

1. Press and hold **Prg** for 2 seconds until the Status LED turns green, then release **Prg**. The fan will turn off to allow the engine warm up faster
2. When the engine reaches the desired turn on temperature, press **Prg** to save the new turn on temperature
 - 2a. Or, press **Skip** to keep the previously programmed turn on temperature, and continue to change the 75% temperature
3. Continue idling the engine until it reaches the desired 75% temperature point, then press **Prg** again to save the new 75% temperature
 - 3a. Or, press **Skip** to keep the previously programmed 75% temperature point, and return to normal operating mode

Programming will then finish, both the Status and Error LEDs will turn off for one second, then the controller will return to normal operating mode.

Definitions:

Turn on temperature – This is the temperature where the fan will turn on to 25%. The fan will turn off when the temperature has dropped approximately 3-5°F below the turn on temperature.

75% temperature point – This is the temperature where the fan will operate at 75% speed. When manually choosing temperature points, after saving a new high point, the fan should immediately turn on to 75%.

Example:

The engine is idled from cold and allowed to warm up. The turn on temperature is manually set at 180°, and the 75% temperature is manually set once the engine reaches 200°. This will put the full speed temperature at 206°, and the fan will turn off after the engine temperature drops below ~176°.

Choose Temperature Sensor:

This option allows selection of the installed temperature sensor to enable the use of one of the pre-set temperature ranges. If use of a pre-set temperature range is not desired, the controller may be programmed by setting the turn on and 75% temperature points, and ignoring this option.

Use:

1. Press and hold **Prg** for 4 seconds, until the Status LED turns Red, then release **Prg**
2. Press **Skip** to switch between selecting the GM sensor, and the Autometer (AM) sensor
3. Press **Prg** to save the currently selected sensor
 - 3a. Or, hold **Skip** for 4+ seconds to exit programming without changing the previously selected sensor

By default, when a sensor is chosen, pre-set temperature range #1 will automatically be selected and saved. The turn on and 75% temperature points may then be selected, or a different temperature range may be selected.

Note:

Selecting a sensor that is not installed, then selecting a temperature range will result in unexpected fan behavior

Choose Pre-set Temperature Range:

This mode allows selection of one of three pre-selected temperature ranges, assuming the installed temperature sensor has already been selected.

The full speed temperature will be automatically calculated from the two temperature points.

Use:

1. Press and hold **Prg** for 6 seconds, until the Status LED turns Orange, then release **Prg**
2. Press **Skip** to switch between the three ranges
3. Press **Prg** to save the currently selected range
 - 3a. Or, hold **Skip** for 4+ seconds to exit programming without changing the previously selected range

Pre-set temperature ranges available for selection:

Range #	Turn On Temperature	75% Temperature	Full Speed Temperature	Error LED color
1	170°	185°	190°	Green
2	190°	205°	210°	Red
3	200°	215°	220°	Orange

Reset all variables:

Press and hold both **Prg** and **Skip** together for 10 seconds, until both the Status and Error LEDs turn Orange, and then release both of them. This will reset the saved temperature points, saved sensor, and the saved temperature range.

Error Modes

When an error is detected, the Status LED on the controller, and the Remote Status LED (if installed), will blink a repeating error code. This code consists of the following number of blinks in a row, followed by a brief pause, then the code again. Only one code will be shown at a time. During each error mode, the fan will be commanded to run at full speed.

Code	Problem	Solution
2	Current sensor does not match the stored sensor	<ul style="list-style-type: none">- The active temperature sensor (EFI or standalone) is stored during programming. If the detected sensor changes to the other sensor, the fan will operate at full speed until reprogrammed with the new sensor, or until the previous sensor is hooked up again.- The sensors are assumed to be missing if their voltage is below 0.25v, or above 4.9v.
3	Neither sensor is installed, or one/both are grounded	<ul style="list-style-type: none">- If the active temperature sensor is shorted to ground, or the wire breaks open, the fan will operate at full speed.- Verify that all temperature sensor wires are connected with no shorts to ground.- If piggybacking on an EFI sensor, verify that the correct wire was tapped into. Often, one wire will be ground, and the other will have the variable voltage signal.- For a single terminal sensor, verify a good connection between the sensor body and ground. Using tape or sealant on the threads may prevent it from working properly.
4	Spread between turn on and 75% temperature points are too close to each other	<ul style="list-style-type: none">- The controller requires at least 0.1v between the turn on and 75% temperature points. Try re-programming with the turn on point lower, and/or the 75% point higher.

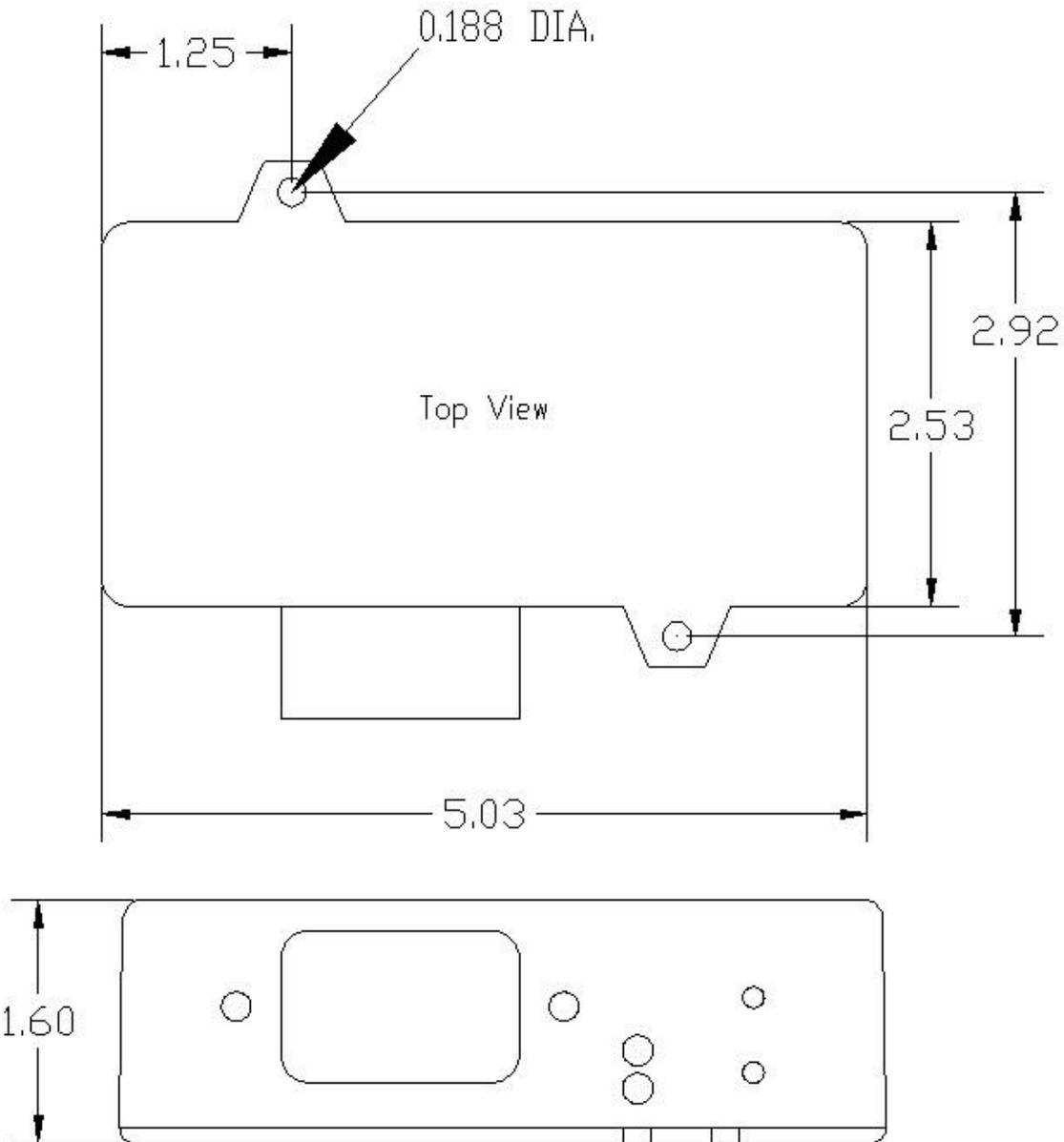
Troubleshooting

Problem	Solution
Fan does not turn on	<ul style="list-style-type: none"> - Verify that the fan has a constant 12v to it. - Verify that the controller has power and that the LEDs are on. - Verify the Speed and Trigger wiring between the fan and the controller. - Test the fan by disconnecting the controller, and jumping 12v to the Trigger pin in the fan plug. After a moment the fan should turn on and go to full speed.
Fan does not turn on with air conditioning input	<ul style="list-style-type: none"> - Verify that the AC system is either grounding or providing 12v to the air conditioning input. - Wait 5 seconds for the fan to turn on.
After a short delay, the fan turns on, and won't turn off	<ul style="list-style-type: none"> - Check the Remote Status LED to see if it blinks 3 times after being steady for 5 seconds. This indicates that the air conditioning input is active. - Disconnect the air conditioning input as a temporary test to verify that the fan no longer turns on after a short delay. - Verify that the air conditioning input is not being grounded or tied to +12v, unless the system is commanding it.
Programmed values not being saved	<ul style="list-style-type: none"> - Make sure you pressing the Prg button to save values, and not the Skip button.
Fan behaves erratically	<ul style="list-style-type: none"> - If the fan behaves erratically, there may be a ground loop issue. To resolve this depends on the temperature sensor used: <ul style="list-style-type: none"> o EFI – Ground the controller (pin 6) to the same point that the ECU is grounded to. o 1 wire sensor – Ground the controller to the engine block, as close to the sensor as possible.

Mounting the controller

We recommend using two #6 self-tapping screws to mount the controller, either in the engine bay, or under the dash. Mark and predrill the holes, then mount the controller.

The controller is NOT sealed against water, so ensure that any locations will be free from water splashes. Also, avoid any excessively hot areas under the hood.



All dimensions in inches

Figure 9 - Controller mounting dimensions

Revision History

Document version	Changes	Date
Rev 1.0	Initial Release	April 7, 2014
Rev 1.1	Corrected AC wire color to Blue from Brown. Added dash temp gauge driving. Added notes about avoiding ground loops, and further troubleshooting tips.	April 22, 2015

Warranty

Micro Automations LLC warrants this product to be free from defects in material and workmanship for a period of twelve (12) months from the date of sale of the original purchaser. Micro Automations LLC will repair this product free of charge if, in the judgment of Micro Automations LLC it has been proven defective within the warranty period. The product should be returned, at the customer expense, to the location of original purchase. This warranty does not cover any expenses incurred in the removal and/or reinstallation of the product. Micro Automations LLC is limited in liability to the original sale price of the product.

This warranty does not apply to any product damaged by improper installation, misuse, abuse, improper line voltage, fire, flood, lightning, or other acts of God, or a product altered or repaired by anyone other than Micro Automations LLC. This warranty is in lieu of other warranties, expressed or implied, including any implied warranty of merchantability. No person is authorized to assume for Micro Automations LLC any other liability concerning the sale of this product.