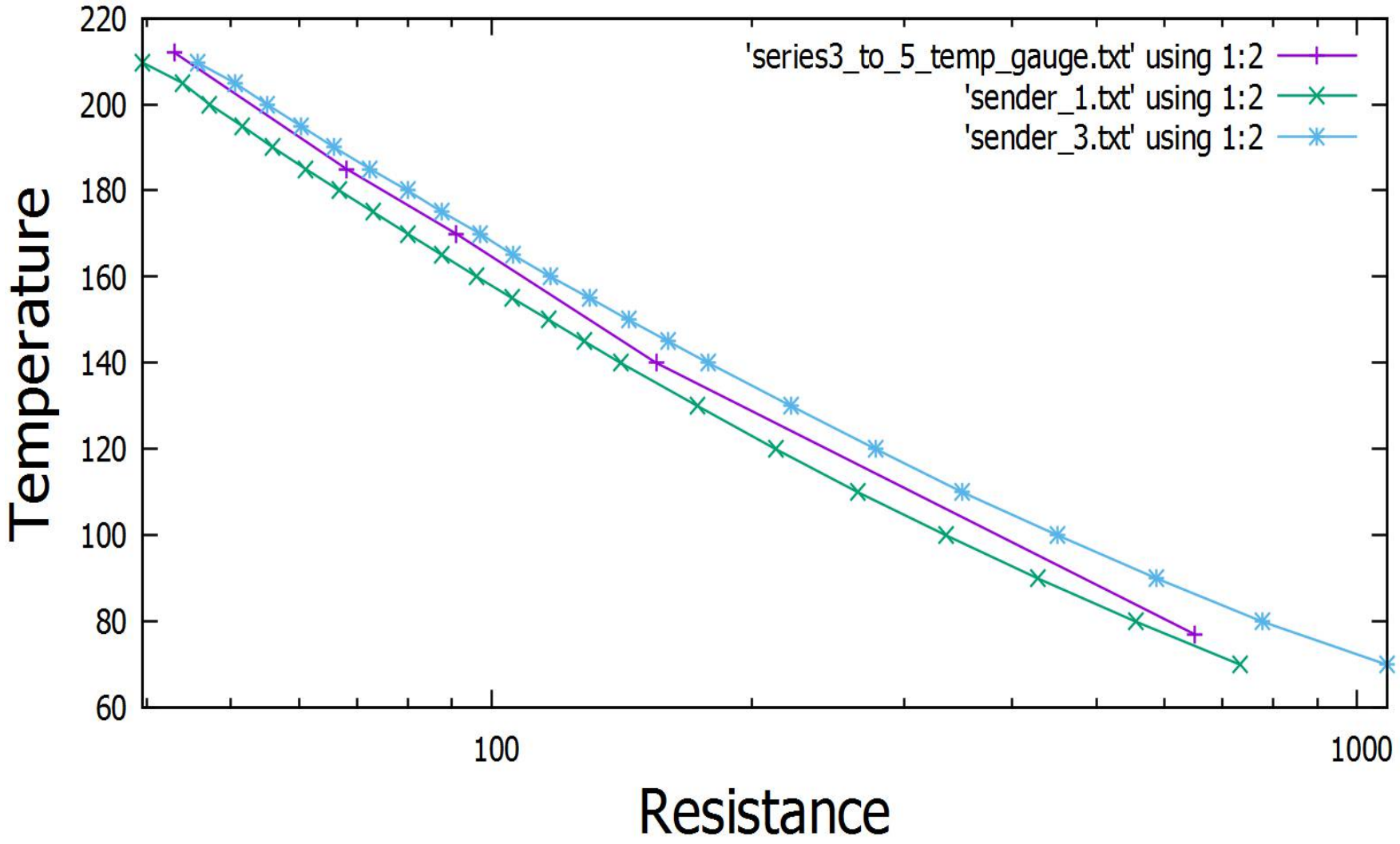
# Senders Summary Report

April 24, 2019
Version: 2

## *Senders 1 & 3*

These are 1/8 NPT threads (27 TPI), so they fit the 2.8L V6 Offy manifold.

# Temp Senders vs Temp Gauge

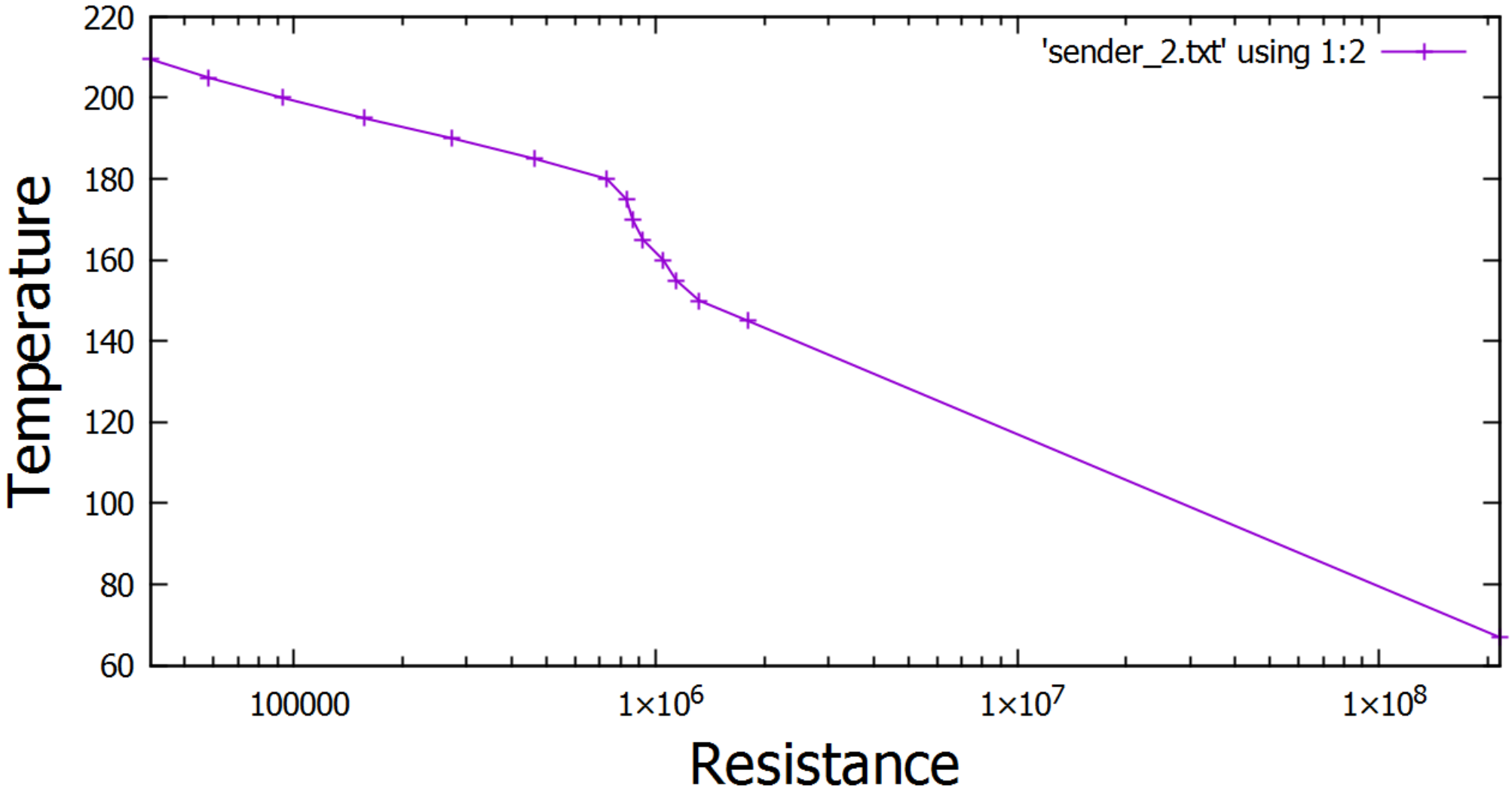


## Senders 1 & 3 Analysis:

- The Purple line is the temperature gauge.
- The Green line is sender #1.
- The Blue line is sender #3.
- Sender 1 resistances are lower than the Temp gauge expects. That means the temp gauge will read ***higher*** than the actual coolant temperature.
- Sender 3 resistances are higher than the Temp gauge expects. That means the temp gauge will read ***lower*** than the actual coolant temperature.
- Sender 3 gets closer to what the gauge expects at higher temperatures. E.g. It is 72.4 ohms at 185 degrees, which is fairly close to the 68 ohms that the temp gauge expects. It looks like the sender will be off by about only 3 degrees at around normal operating temperature (185 to 190 degrees). ***It seems like a usable option.***

## *Sender 2*

This sender is 1/8 NPT threads (27 TPI), so it fits the 2.8L V6 Offy manifold.


Sender 2
'sender_2.txt' using 1:2
Temperature
220
200
180
160
140
120
100
80
60
100000
1×10^6
1×10^7
1×10^8
Resistance

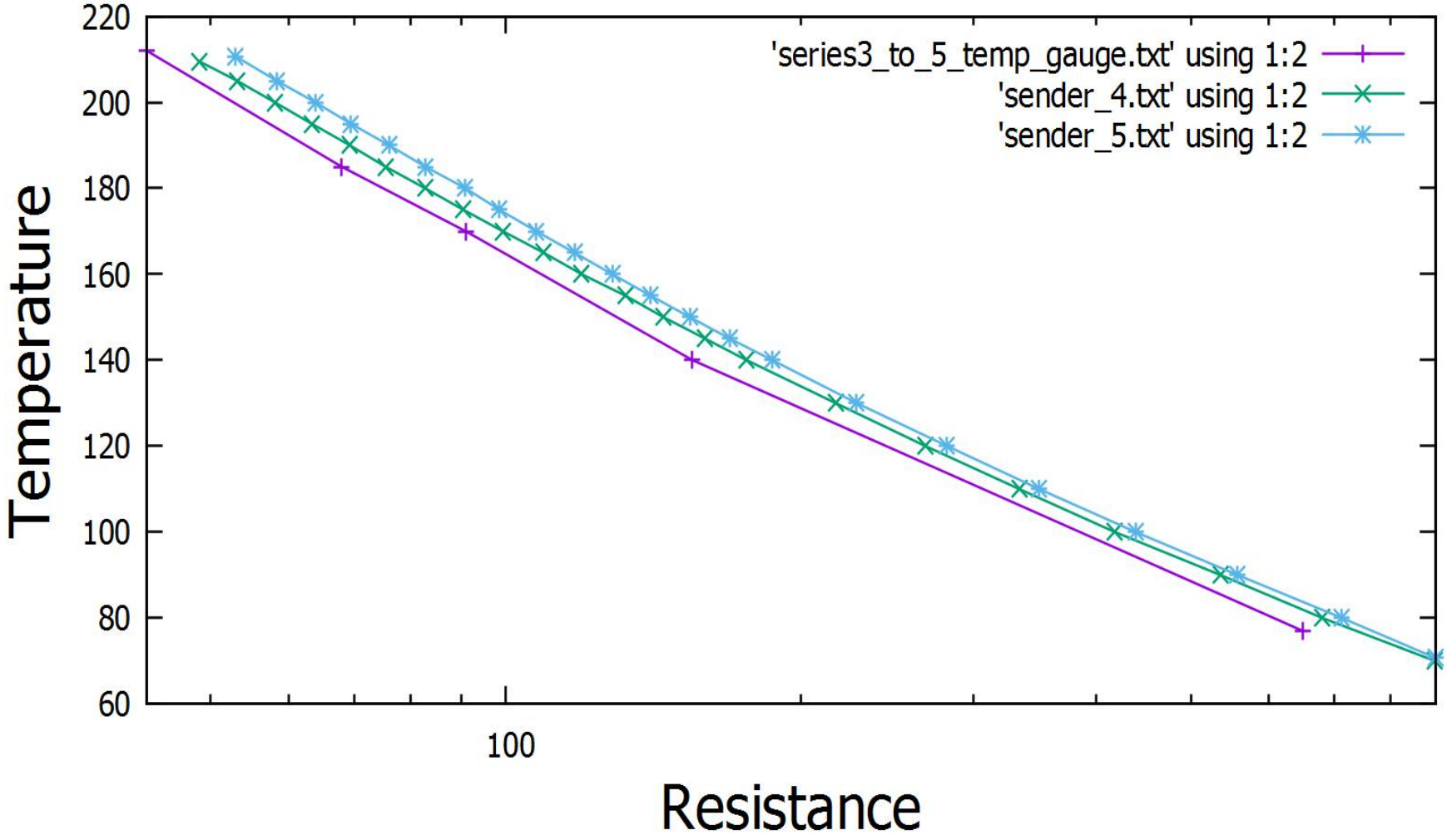
## Sender 2 Analysis

The resistance readings from this sender are really high – in the mega ohms and kilo ohms scale. Definitely not a usable sender for an Alpine series 3 to 5 temperature gauge.

### *Senders 4 & 5*

These are Smiths TT4802/00 senders, which is the original Sunbeam Alpine series 3 to 5 sender. The threads are 5/8" – 18 TPI.

# Temp Senders vs Temp Gauge



## Senders 4 & 5 Analysis:

- The Purple line is the temperature gauge. The Green line is sender #4. The Blue line is sender #5.
- Both sender 4 and 5 provide resistances slightly higher than the Temp gauge expects. This means the temp gauge will read lower than the actual coolant temperature.
- Sender 4 is closer to what the gauge needs than sender 5. It looks like sender 4 will read about 5 degrees low at around normal operating temperature (185 to 190 degrees).

## Item #6

Item has 3/8 NPT threads. Has no markings. Tested it from room temperature to 209.3 degrees. It is always an open circuit. It could be a defective temp sender, or maybe a defective cooling fan thermal switch.

## Cooling Fan Thermal Switch (#7)

Item has 3/8 NPT threads. It has the following markings: T-0-0  48T  32425  F180F  J0902  TCS-352A-180

An internet search found a hit on a similar part #: TCS-352-180. (http://www.electricfanengineering.com/temperature-pressure-switches/) That part is a 180 degree cooling fan temperature switch, with the specs below. Web site says the part has a +/- 12 degree accuracy for opening / closing temperatures.

| MODEL # | FITTING DIAMETER | CLOSE* | OPEN* | VOLTAGE(1) | MAXIMUM AMPERAGE |
|---|---|---|---|---|---|
| TCS-352-180(3) | 3/8" NPT | 185° F | 175° F | 12 | 25 |

The test results were that the item was an open circuit until it reached 185.7 degrees. Then it "closed" internally, creating a connection between the two connectors. It remained "closed" until it cooled down to 165.3 degrees. Then it opened back up again.

So it is a working thermal switch for kicking a cooling fan on and off. (Of course it is used to control a relay, not directly send the power to the cooling fan.)

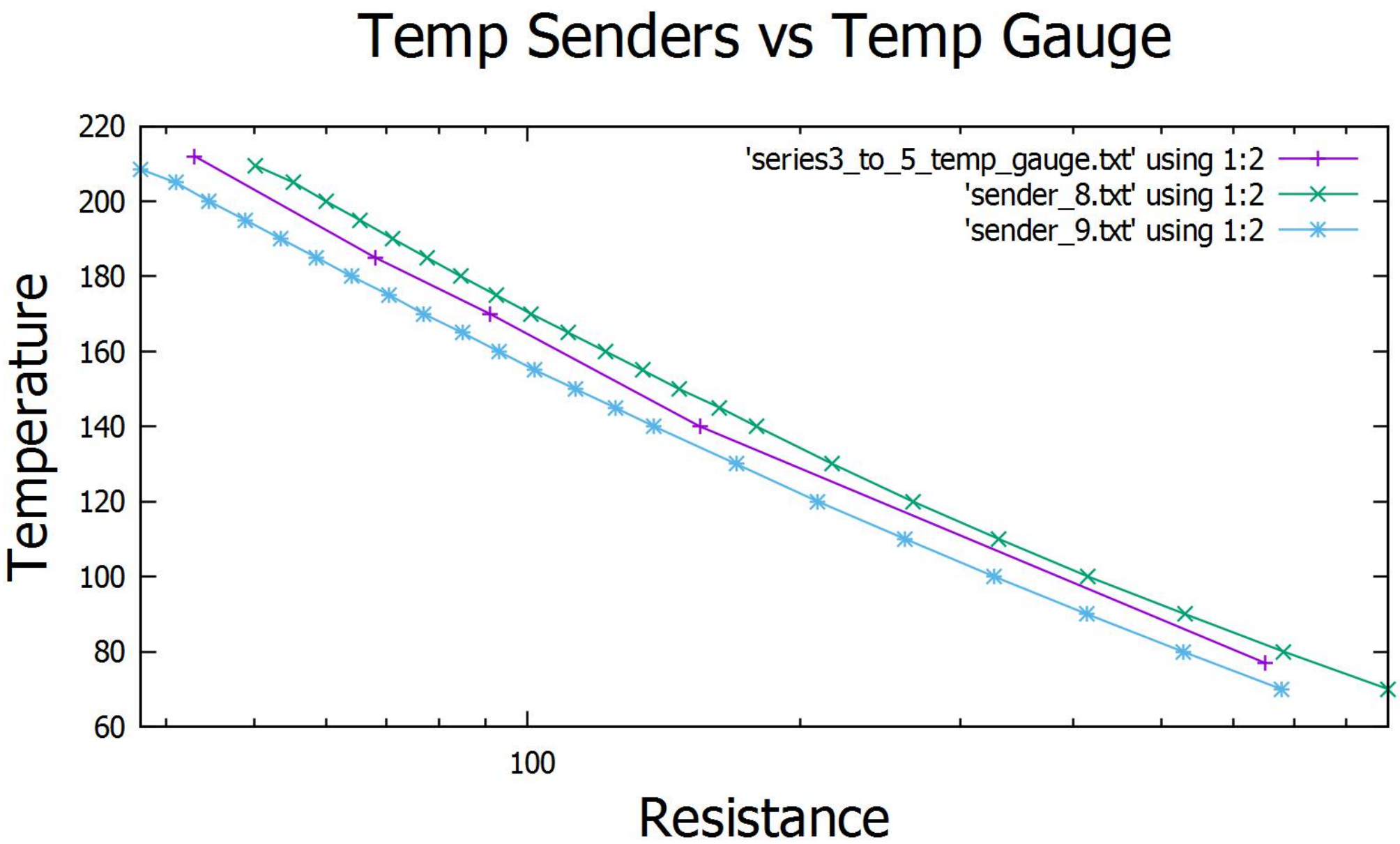
## Senders #8 & #9

These are 1/8 NPT threads (27 TPI), so they fit the 2.8L V6 Offy manifold.

I bought these new from Summit Racing to see if I can identify a source for temperature senders for folks doing 2.8L conversions into Alpines.

Sender #8 is New Vintage USA 99005-40.

Sender #9 is VDO 323-095.


Temp Senders vs Temp Gauge
Temperature
Resistance
220
200
180
160
140
120
100
80
60
100
'series3_to_5_temp_gauge.txt' using 1:2
'sender_8.txt' using 1:2
'sender_9.txt' using 1:2

## Sender 8 (New Vintage USA 99005-40) & Sender 9 (VDO 323-095) Analysis:

- The Purple line is the temperature gauge.
- The Green line is sender #8 (New Vintage USA 99005-40).
- The Blue line is sender #9 (VDO 323-095).
- The New Vintage USA sender resistances are slightly higher than the Temp gauge expects. That means the temp gauge will read ***lower*** than the actual coolant temperature. The New Vintage USA sender will result in the Temp gauge reading about 7 degrees lower than the actual coolant temperature at around normal operating temperature. E.g. When the coolant is 185 degrees, the temp gauge will read around 178 degrees.
- The VDO sender resistances are lower than the Temp gauge expects. That means the temp gauge will read ***higher*** than the actual coolant temperature. The VDO sender will result in the Temp gauge reading about 9 degrees higher than the actual coolant temperature at around normal operating temperature. E.g. When the coolant is 185 degrees, the temp gauge will read around 193 degrees.

My thought is that the New Vintage USA sender is the better option. With this sender, the temperature gauge should normally read slightly left of middle when the car is at normal operating temp (185). If the temperature gauge is reading higher than its mid-point, the car is running hotter than it should.

With the VDO sender, the temperature gauge will always read to the right of the middle at normal operating temperature. It might be a tad harder to notice when the car is running hotter than it should, since the gauge needle is always to the right of the mid-point at normal operating temperature.

**A compensation option for the VDO sender**

The VDO sender consistently provides a slightly lower resistance than the series 3 to 5 temperature gauge needs. That means it can be easily compensated. The key temperature range area to consider is around the normal operating temperature – 185F. Looking at resistances provided by the sender from 170F on up to 212F, the VDO sender is about 9 or 10 ohms lower than the gauge needs. Therefore, a 9 or 10 ohm resistor can be added in series to the temperature sender to increase the resistance seen by the gauge. That would provide accurate resistances for the gauge for this temperature range.

Resistor details: Normally I'd suggest to use a 1% tolerance resistor for accuracy. However, given the small resistance value and the relatively small contribution this compensation resistor provides to the resistance seen at the gauge, using a 5% tolerance resistor should be fine, too, and is a little cheaper. I'd size the resistor's power handling rating so it can handle the sender wire being disconnected from the sender and then directly connected to ground (as people sometimes do as a test of the temp gauge / voltage stabilizer). Assuming the car is running, the gauge can be receiving 14.4 volts. That requires the resistor to be rated to handle at least a 1/2 watt.

## Test data used to plot the graphs

# sender number 1
# 1/8 NPT-27
# 120 degree C
#
# Resistance Temp values

| | |
|---|---|
| 733 | 70 |
| 555 | 80 |
| 428 | 90 |
| 335 | 100 |
| 265 | 110 |
| 213 | 120 |
| 173 | 130 |
| 141 | 140 |
| 128 | 145 |
| 116.5 | 150 |
| 105.7 | 155 |
| 96.2 | 160 |
| 87.7 | 165 |
| 80 | 170 |
| 73 | 175 |
| 66.7 | 180 |
| 61 | 185 |
| 55.9 | 190 |
| 51.5 | 195 |
| 47.2 | 200 |
| 43.9 | 205 |
| 39.5 | 209.7 |

# sender number 2
# 1/8 NPT-27
# Not sure what type of readings this sender represents
#
# Resistance Temp values

| | |
|---|---|
| 215000000 | 67 |
| 1800000 | 145 |
| 1320000 | 150 |
| 1140000 | 155 |
| 1050000 | 160 |
| 923000 | 165 |
| 864000 | 170 |
| 830000 | 175 |
| 733000 | 180 |
| 462000 | 185 |
| 274000 | 190 |
| 156000 | 195 |
| 93000 | 200 |
| 58100 | 205 |
| 40200 | 209.5 |

# sender number 3
# 1/8 NPT-27
#
# Resistance Temp values
1083 70
777 80
587 90
451 100
350 110
278 120
222 130
178 140
160 145
144 150
130 155
117 160
106 165
97 170
87.7 175
80 180
72.4 185
65.8 190
60.2 195
55 200
50.5 205
45.8 209.6

# sender number 4
# Smiths TT4802/00 (for Alpine series 3 to 5)
# 5/8" - 18 TPI
#
# Resistance Temp values
887 70
681 80
536 90
418 100
334 110
268 120
217 130
176 140
159.7 145
144.8 150
132.4 155
119.5 160
109.3 165
99.3 170
90.5 175
82.7 180
75.4 185
69.3 190
63.4 195
58.1 200
53.2 205
48.7 209.5

# sender number 5
# Smiths TT4802/00 (for Alpine series 3 to 5)
# 5/8" - 18 TPI
#
# Resistance Temp values
888 70.7
713 80
558 90
439 100
350 110
282 120
228 130
187 140
169.2 145
154.1 150
140.5 155
128.4 160
117.5 165
107.4 170
98.5 175
90.9 180
82.8 185
76.0 190
69.5 195
63.9 200
58.4 205
53 210.7

# series 3 to 5 temperature gauge
#
# Resistance Temp values
650 77
155 140
91 170
68 185
43 212

# sender number - 8
# New Vintage USA 99005-40
# 1/8 NPT - 27
#
# Resistance Temp values

| | |
|---|---|
| 889 | 70 |
| 682 | 80 |
| 531 | 90 |
| 415 | 100 |
| 331 | 110 |
| 266 | 120 |
| 217 | 130 |
| 179 | 140 |
| 163 | 145 |
| 147 | 150 |
| 134 | 155 |
| 122 | 160 |
| 111 | 165 |
| 101 | 170 |
| 92.4 | 175 |
| 84.5 | 180 |
| 77.5 | 185 |
| 71.1 | 190 |
| 65.4 | 195 |
| 60 | 200 |
| 55.3 | 205 |
| 50.1 | 209.6 |

# sender number - 9
# VDO 323-095
# 1/8 NPT - 27
#
# Resistance Temp values

| | |
|---|---|
| 678 | 70 |
| 528 | 80 |
| 414 | 90 |
| 327 | 100 |
| 261 | 110 |
| 209 | 120 |
| 170 | 130 |
| 138 | 140 |
| 125 | 145 |
| 113 | 150 |
| 102 | 155 |
| 93 | 160 |
| 84.8 | 165 |
| 76.9 | 170 |
| 70.5 | 175 |
| 64 | 180 |
| 58.6 | 185 |
| 53.5 | 190 |
| 48.9 | 195 |
| 44.6 | 200 |
| 41 | 205 |
| 37.5 | 208.5 |