

Repair / Upgrade for Sunbeam Alpine Electronic Tachometer

By
Tom Hayden

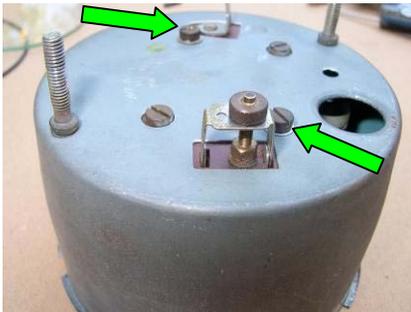
(applicable to Series V tach models 2411/01 and Series IV models 2404/00A, and 2404/00B)

Disassembly:

The first step is to disassemble the tach by removing the chrome ring and glass. This is done by rotating the chrome ring until the tabs line up with the slots in the case. It may be helpful to use a rubber pad such as used in the kitchen for removing tops of pickle jars. It may also help to bend the tabs slightly upward, but be careful so as not to distort the ring. Remove the ring, the glass, and the inside bezel.



Next remove the 2 screws holding the assembly into the housing and carefully drop the assembly into your hand



It may be helpful to review other articles such as the following to gain understanding about these tachs:

<http://www.classictiger.com/techtips/motach.html>

Replace aged, defective, unstable components:

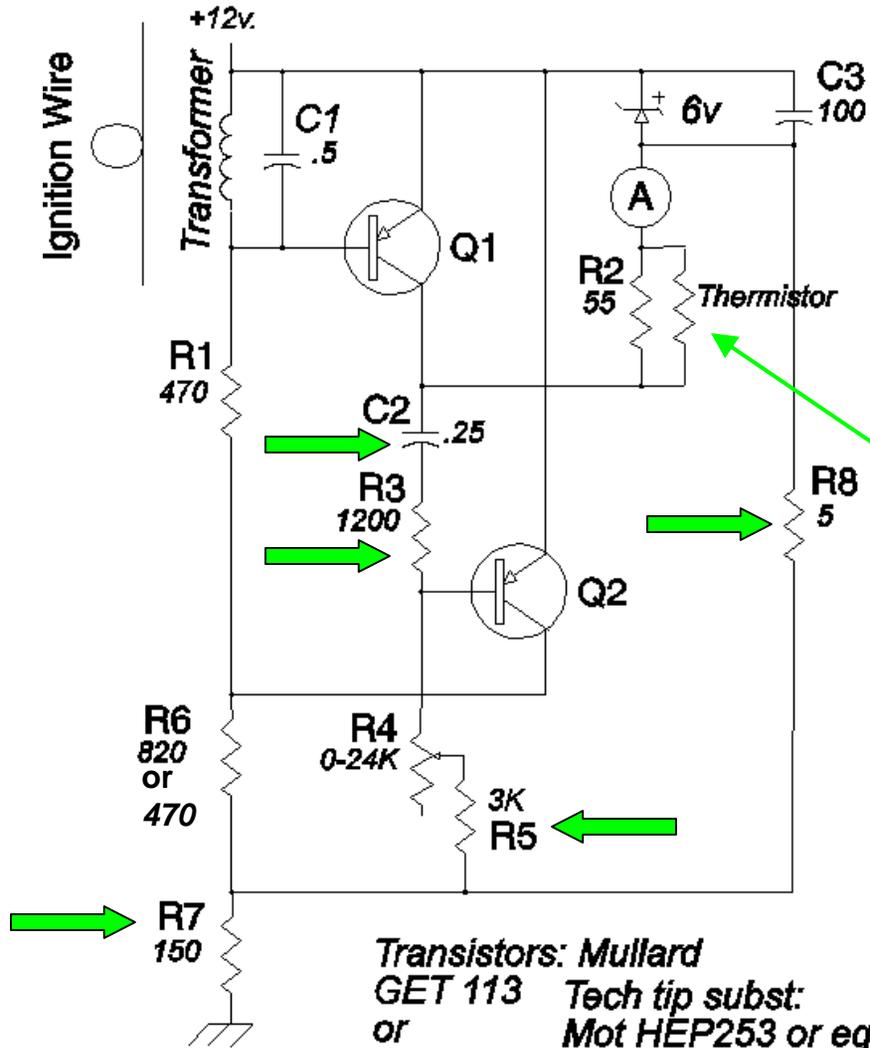
I have analyzed and repaired 10 of these tachs and this instruction is based on that experience. I have not seen a single transistor fail, but the referenced article describes suitable replacements if that is the problem. The repairs I describe resolve all the problems I have seen to date, except for 2 tachs that had failed meter movements- the coil was open. I have not found any way to repair a tach with this problem.

I strongly recommend that all the component replacements I suggest be done. I have been amazed at how far these parts have shifted over time. Granted these are over 40 years old, but I had not previously realized in my electronic engineering experience how badly some of these parts will shift with age. Many have shifted 50 to 100% from the original value. On no units have I seen any significant change in the 56 ohm (not 55 as shown in the schematic) resistor R2, so I see no reason to replace it. It is one of the few high quality parts used in the original.

I did considerable research and testing on the thermistor and temperature compensation. I determined that the thermistor is used to provide temperature compensation to compensate for the temperature coefficient of the copper coil in the meter, which would cause the meter to read low when warmer than the temp at which it was calibrated. This is because the output of the electronic circuit is a voltage, whereas the meter responds to the average current. When the copper coil resistance increases as the temperature goes up (by about 0.4% per deg C) the current through the meter is reduced due to the higher resistance. I have measured 5 thermistors from various Alpine tachs, and find they ranged from 150 to 175 ohms at 25C. It is difficult to tell what the original values were, but I strongly suspect that all the original thermistors have drifted far from their original values. From tests I conducted on those 5 thermistors I have determined that their present characteristics actually overcompensate such that all tachs read significantly high when warm. I have found a commercially available thermistor with a 300 ohm (@25C) that when combined with 34 ohms in series with it provides nearly perfect temp compensation.

In addition to the time drift of the various parts, many also have significant temperature drift which adds to instability and inaccuracy, which is why I replace several additional parts.

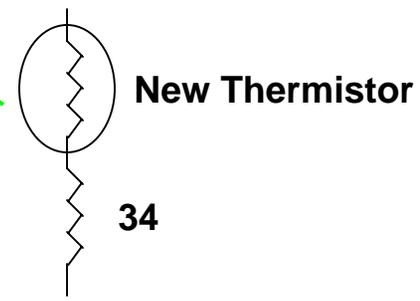
Smiths Tachometer



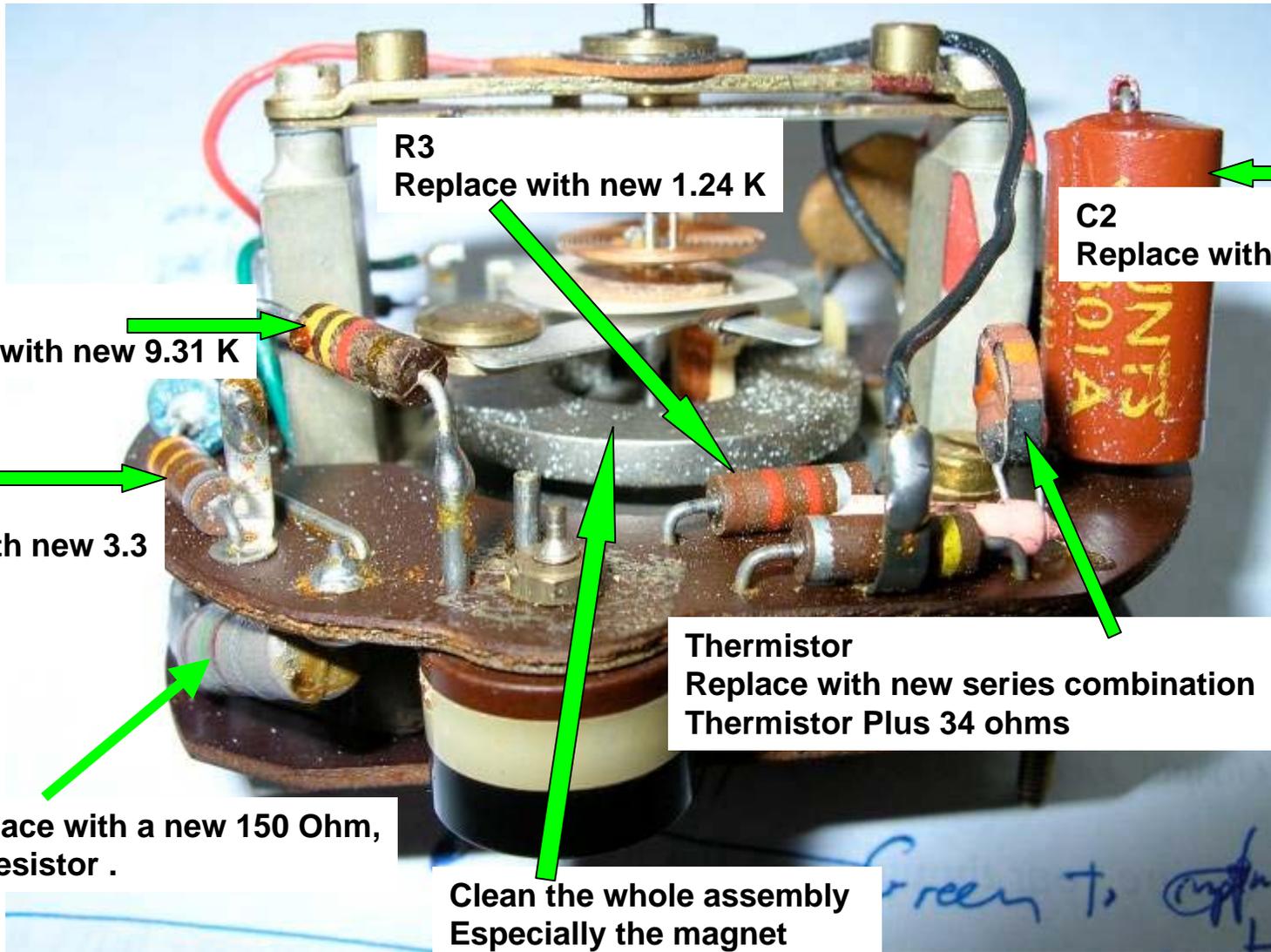
Transistors: Mullard
 GET 113 Tech tip subst:
 or Mot HEP253 or equiv.
 OC83B (eg. NTE158)

We need to replace:

- C2 with a new 0.22 uF cap
- R3 with a more stable modern Res 1.24 k
- R5 with a higher value modern Res 9.31 k
- R7 with a new, more stable, 150 Ohm
- R8 with a new stable 3.3 Ohm
- Old Thermistor with a combination, new (300 Ohm / 3900K) thermistor plus 34 ohms



Original assembly



R3
Replace with new 1.24 K

C2
Replace with new 0.22uF

R5
Replace with new 9.31 K

R8
Replace with new 3.3

Thermistor
Replace with new series combination
Thermistor Plus 34 ohms

R7 Replace with a new 150 Ohm,
2 watt resistor .

Clean the whole assembly
Especially the magnet
CAREFULLY!
Use artists paintbrush and
Q-Tips, dipped in alcohol

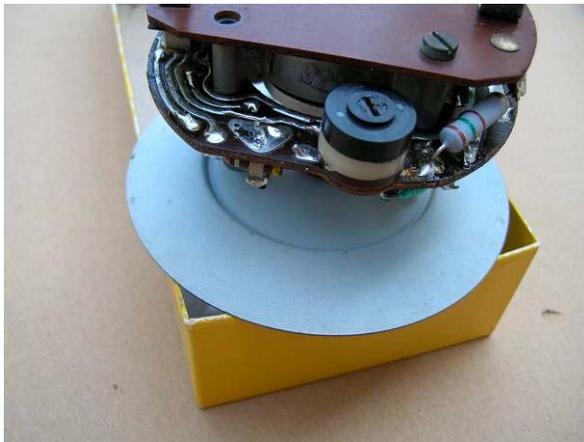
Notes:

Removing C2, R3, R5, R7, R8 is easy. Their ends may be bent over but still removal should not be difficult.

But removing the thermistor may be more difficult because one end may be soldered into the same hole as the 56 ohm resistor and the other end is soldered into a hole almost under the 56 ohm resistor.

When installing the new combination of thermistor and 34 ohms it may be simpler to just tack solder the left end (as viewed in the photo) of the combination to the junction post with the black wire soldered to it. This is the same electrical point as the hole almost under the 56 ohm resistor.

I find it quite possible to make these changes without removing the dial or needle. When working on the top side (as shown in the photo) the assembly is easily supported resting on its back side. But when working on the back side of the board, where the solder and circuit traces are, I find it very handy to support the tach on its dial face by setting it, face down, on the edges of a small box with no top- a small box like a jewelry box with its lid off. Set the tach so the dial face rests on the edges with the needle free to swing and pivot somewhat. Do not set the tach face down on the needle on a hard surface.



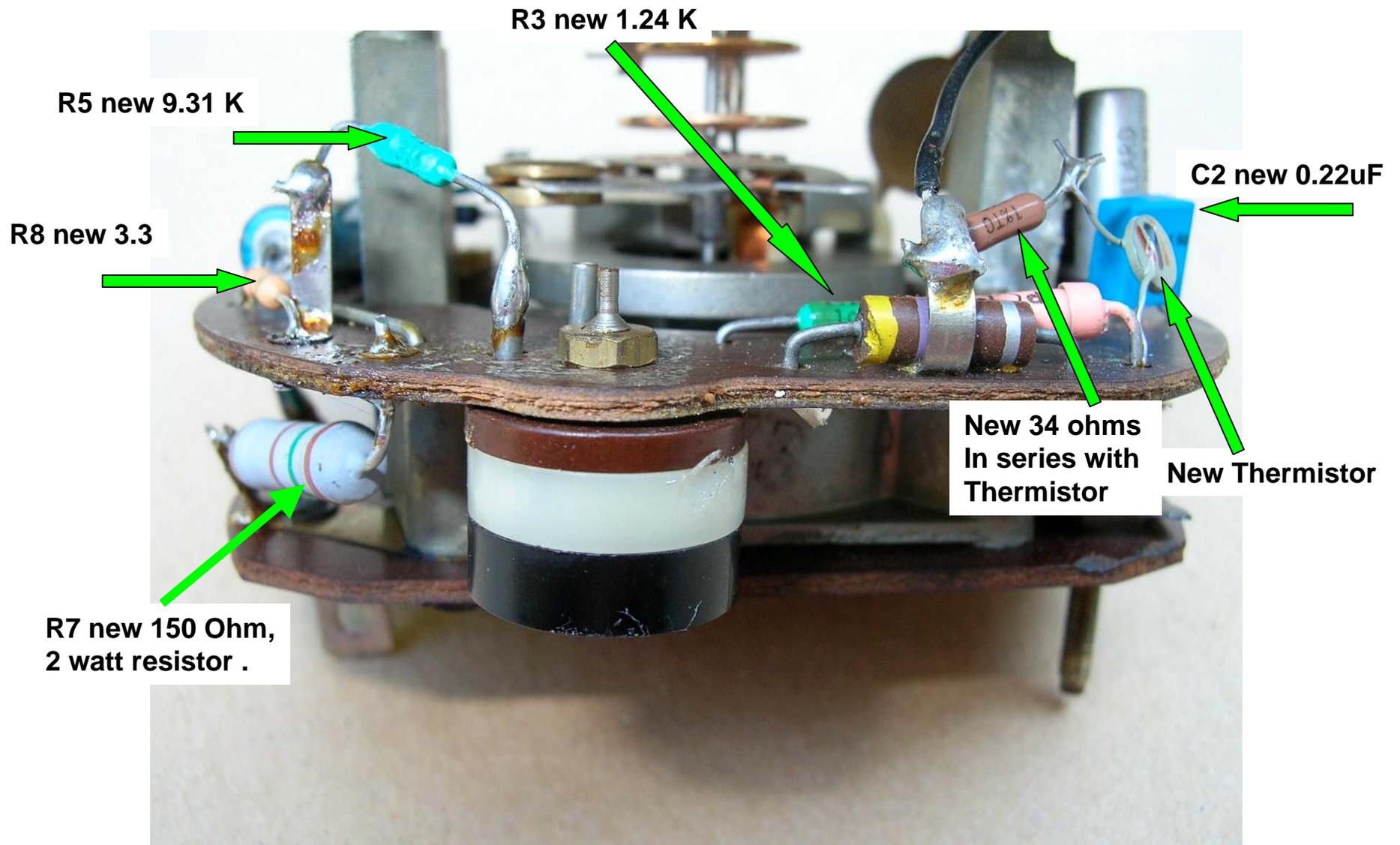
Notes:

The reason for replacing R5 with a 9.31k is to reduce the adjustment range of the adjuster and increase the stability of the timing. An old adjustable resistor as used in this tach is not very stable over time or temperature, so reducing its effect reduces the drift. This also reduces its adjustment range, which is not a problem as long as the tach is used for a 4 cyl engine. The value of this resistor is not critical. Any value from about 3k to 15k will probably be OK because the adjustable resistor sets the actual total resistance and the combination of C2 and this resistance determines the pulse width of the pulse train. But the resistor should be one with a good temperature stability. And the larger the value used for R5, the less resistance from the variable resistor is used, and the better the temperature stability of the pulse width and thus the overall accuracy.

CLEAN THE ASSEMBLY!

It is also important to clean the assembly and the case. The clearances between the moving coil and the circular magnet are very close. In many tachs I have found metal shaving and almost always paint flakes. This debris will cause stickiness in the meter movement and results in inaccurate RPM readings. I use artists paintbrushes and Q-Tips dipped in alcohol to carefully clean everything.

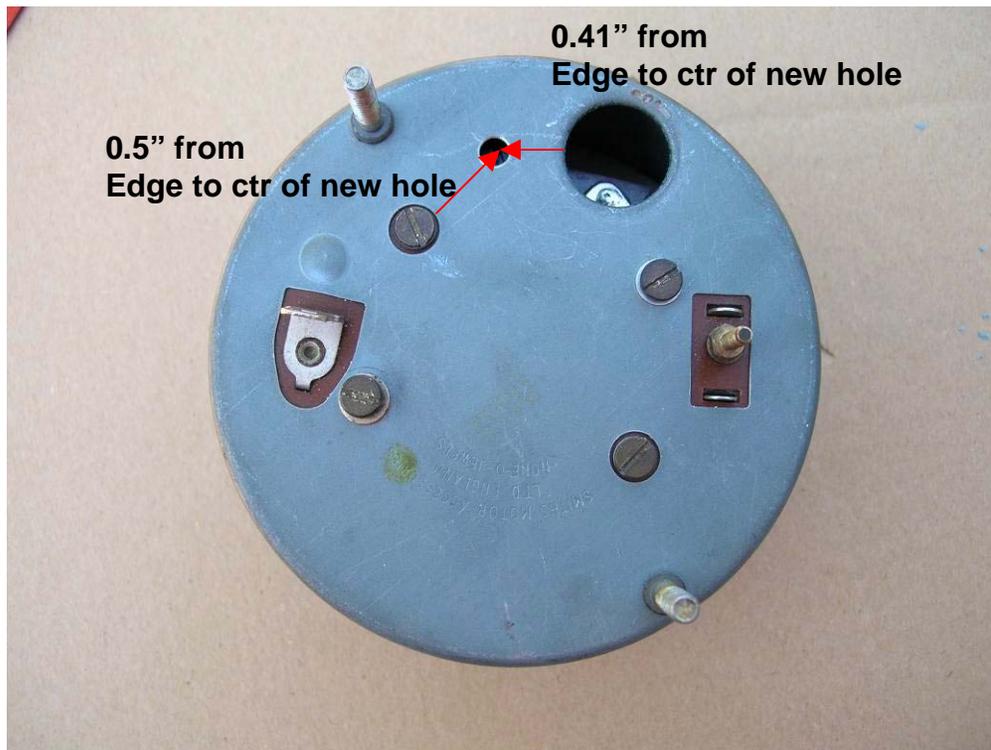
Upgraded assembly



Add a calibration access hole:

Before installing the assembly into the housing I suggest drilling a 3/16" (or so) hole in the rear of the case to provide access to the adjustment pot. This allows adjustment of the tach after it is mounted in the case. Otherwise there is a slight shift in calibration after mounting in the case.

Be sure to put tape or other means over the hole after calibration to keep out moisture, dirt, dust, and bugs

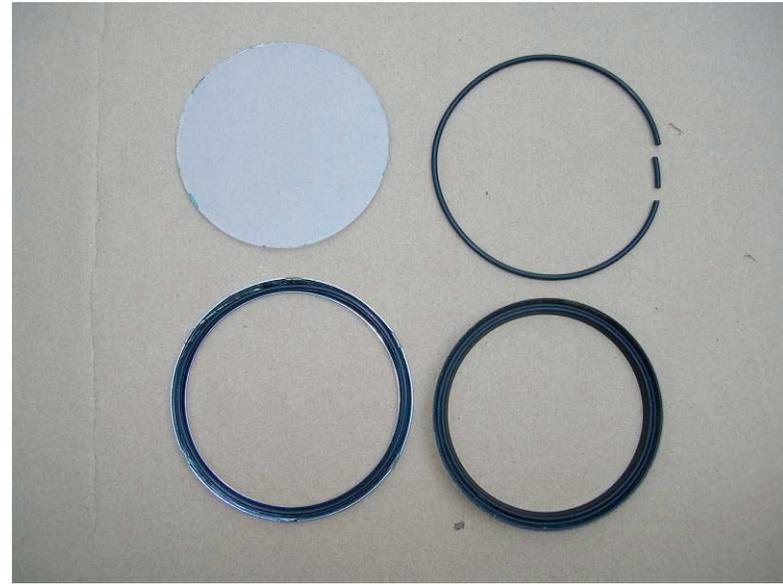


O-Rings:

Use the 2 new thick (0.10") O rings to mount the glass and chrome ring. One ring fits exactly as is into the chrome ring.

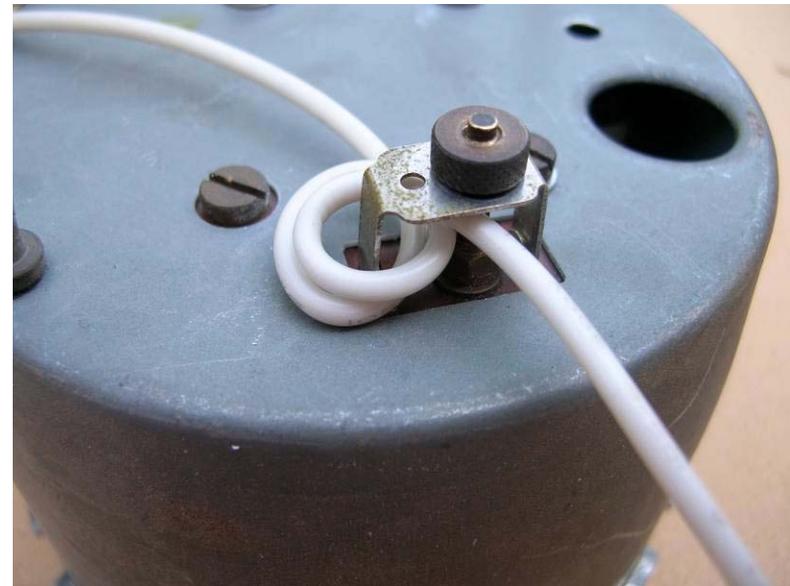
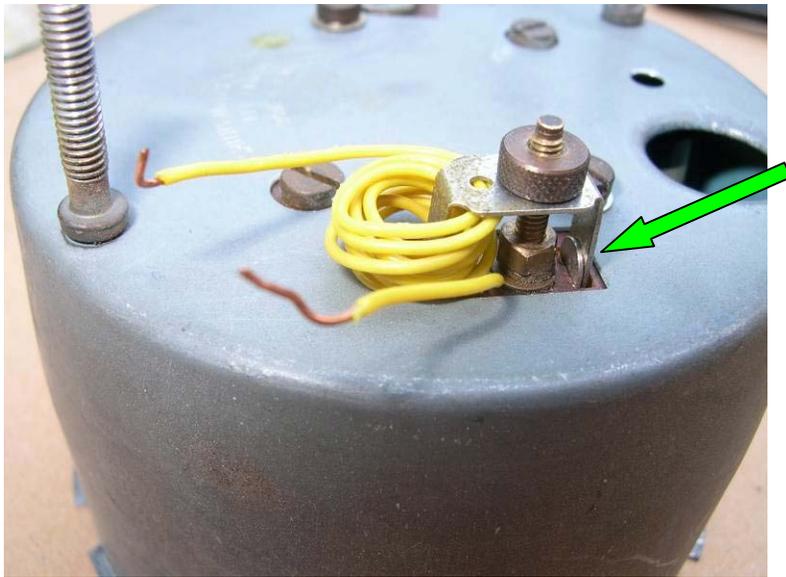
The other O-Ring requires cutting out a segment (approx 1/2") to allow it to fit snugly into the bezel

There is a third O-Ring, thinner in cross section, that goes outside the case and acts a a gasket between the housing flange and the dash panel. These were installed on all Alpines, but I am not sure how necessary they are.



After installing the assembly into the case and reattaching the bezel, O-Rings, glass, and chrome ring, You can apply a signal to the tach to calibrate it.

If you are using a signal generator (typically with 50 ohm or 600 ohm output impedance) to calibrate the tach you will need to wind 15 to 30 turns of small gauge wire around the U-shaped steel clip in order to couple a large enough signal in.



If you are using the actual ignition signal to calibrate the tach you can just wind a couple turns of the ignition wire through the clip. You do not need to use the plastic piece that is installed in the white wire. For some tachs I have seen a need to wind an extra turn, one more than the 1-1/2 turns originally used, in order to get the tach to respond. It's easy to do if you don't use the plastic piece.

Note that in order for the tach to respond to the ignition pulses, BOTH tips of the little U-shaped steel clip must be in good contact with the mating tip protruding through the case from the other half of the transformer inside.

Tach Replacement Parts

Description	Digi-Key P/N
1 C2- 0.22 uF Cap, 100 VAC (yes, this tiny part is the replacement for the big brown part)	495-2492-ND
2 R3- 1.24k Resistor	CMF1.24KQFCT-ND
3 R5- 9.31k Resistor	CMF9.31KQFCT-ND
4 R 7 - 150 Ohm resistor 2 W, (Large)	150W-2-ND
5 R 8 - 3.3. Ohm res (orange-orange-gold-gold stripes)	3.3QBK-ND
6 Thermistor – 300 Ohm (3900K)	PNT109-ND
7 Series resistor for adding to thermistor – 34 Ohm	CMF34.0HFCT-ND
8 Rubber O-Rings, 2ea. 0.100” , cross section, Use one for under the chrome ring. Cut second one to fit under the glass, inside the black metal bezel.	
9 Rubber O-Ring , 1 ea, 0.070”cross section. Use as the dash mount gasket- goes outside the tach housing.	

I have assembled kits of the above parts for those wishing to upgrade their own tachs.

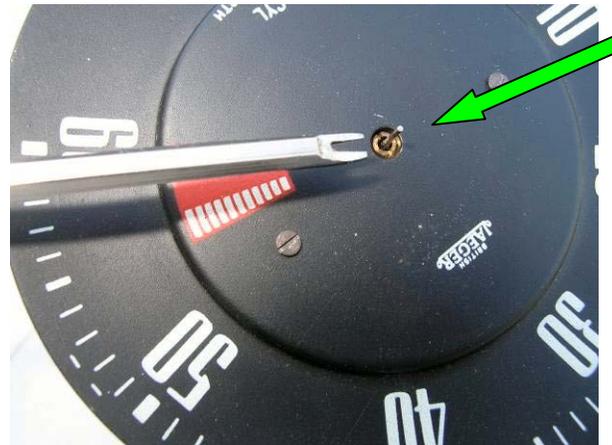
In addition some may find they need these additional parts and I have identified them here but are NOT included in my kits :

- 6.2V zener diode 1N4735ADICT-ND
- R2, 56.0 ohm P56.0CACT-ND
- Q1 or Q2 PNP Ge Transistors ???? Maybe use a modern Silicon type

“Sticky” needles:

I have seen several cases where the needle seemed a bit sticky. That is, it did not move smoothly over the full range of indications. I have read various posts by other Alpine owners about similar problems. Assuming you have cleaned the mechanism and especially the area around the magnet and moving coil, I have found that in most cases this is a case of insufficient end play in the needle pivot. If you have a sticky needle, grab the center “knob” of the needle and push-pull it in and out from the dial. It should have some slight play (about 0.003”), just enough to be observable. If there is no end play you can adjust the end bushing. First remove the needle. I find the best way to remove the needle is by using a pair of small jewelers screwdrivers inserted from opposite sides with their tips touching the dial under the needle “knob” where any scratches from the tips will not show after the needle is reinstalled. Pry evenly on both sides and the needle will pop off. Once the needle is off you need to use a split tip screwdriver as shown in the picture. You can make one by grinding a slot in the tip of a regular, small screwdriver

The slot does not need to be as deep as the needle pivot since you can make the adjustment with the screwdriver at an angle. You’ll only need to turn the adjustable bushing about 1/8 of a turn to make it loose enough to eliminate sticking.



When replacing the needle just press it on to the pivot pin. Initially install it slightly above the “0” position and don’t press it on very hard. Then rotate it into final position at “0” and then press it a bit more firmly on with just finger pressure .

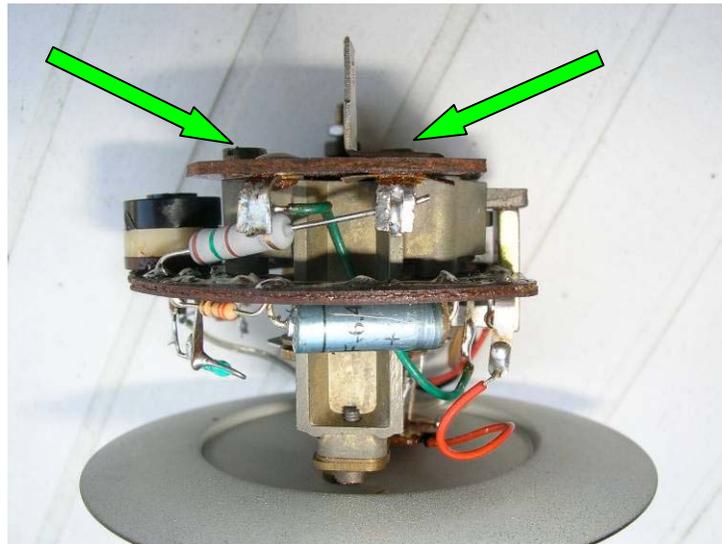
Positive Earth:

The above presentation is based on the Model 2411/01 tachs used on all series V Alpines. These are all Negative earth tachs. There were several versions of Pos earth tachs used on Series IVs, including model 2404/00, 2404/00A, and 2404/00B.

The 2404/00 fitted to early SIVs is significantly different from all later tachs and some lack the internal 6 V zener diode regulator and thus can have substantial errors due to variation of battery/generator voltage. I recommend replacing the tach or the electronics on these units. The meter movement is the same in all.

I have also found several variations on component layout even within the same model number, so your tach may not look exactly the same as my photos show.

The 2404/00A and 2404/00B fitted to later SIVs are nearly identical to the 2411/01 described in this article except for the values of R6 and R7, which are not critical, and for the fact that they are wired as Positive earth. The photo shows what a Pos earth wired unit looks like. In fact this is the electronics from a 2411/01 Neg earth, SV tach, that has been re-wired to be Pos earth. The only differences are the swapping of the green wire and the end of the large resistor, R7. If you have a 2404/00A or 2404/00B and wish to convert it to Neg earth simply swap the 2 connections, moving the end of the resistor to the tab on the left and moving the green wire to the tab on the right (R&L as viewed in this photo)



Tach wired for Positive Earth

Accuracy :

Some have described the accuracy of these tachs across the RPM range as not too good. I disagree. With good stable parts and properly calibrated they are quite good. Every one I have repaired and calibrated will track as accurately as originally designed. You can see the original accuracy “specs” by looking at the dial. On the Series V tachs you will see tiny marks just outside the “hash marks” at 1500, 4000, and 6000 RPM. I assume the tach was adjusted at 1500 and then checked at 4000 and 6000, then readjusted if necessary until the readings were within the noted marks. That would put it within 100 RPM at each cal point. Earlier (positive earth) tachs were cal'd at 1300, 3500 and 5200 RPM.

Here is a typical calibration table from a tach I have restored and calibrated:

Adjusted the tach for best compromise over the full operating range.
Operated the tach for 5 minutes warm up before doing final cal.

Settings and readings (after 5 min operating warm-up):

Applied Freq	Equiv RPM	RPM Reading displayed
30 Hz	900	900
40	1200	1220
50	1500	1450
60	1800	1740
80	2400	2350
100	3000	2950
120	3600	3580
150	4500	4520
180	5400	5400
200	6000	6000