

80s Lamborghini Tachometer Analysis
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Rev 1.2



This document describes the reverse engineering of the Veglia-Borletti tachometer out of a 1987 Lamborghini Jalpa car. The date code on the tachometer is February of 1989, so the tachometer is likely not the original tachometer for this car.

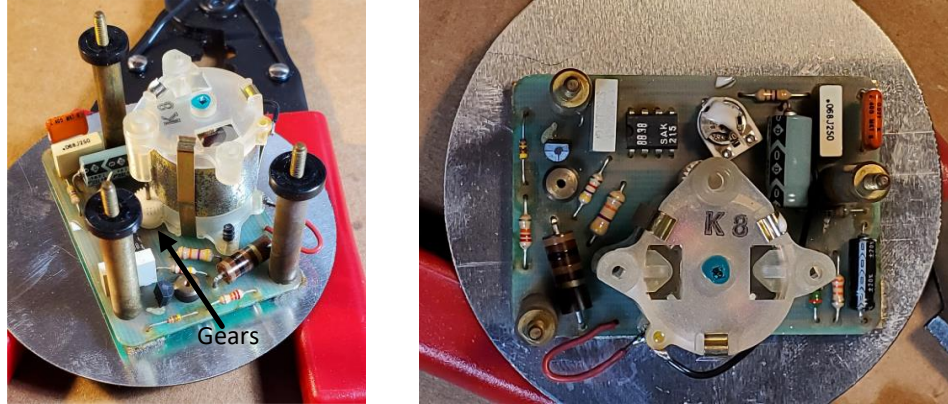
You can see from the photo on the left, that the white paint inside of the case has oxidized and that paint dust has gone throughout the inside of the tachometer. I have annotated the unmarked terminals in the photo on the right for posterity. The front bezel is crimped to the case, making disassembly of this tachometer somewhat difficult.

The owner of this car, Ken Osius, has upgraded his ignition system from the original Bosch 0227300002 module to an MSD 6A ignition system and the tachometer is no longer working in his car. He asked me to try to figure out why it was no longer working and to figure out a way to make it work again.

Since I could not get the tachometer to work with my normal test bench setup either, Ken graciously allowed me to remove the bezel and take the tachometer apart so I could reverse engineer it. I un-crimped the bezel and removed the bezel, trim ring, glass, rubber gasket and glass.

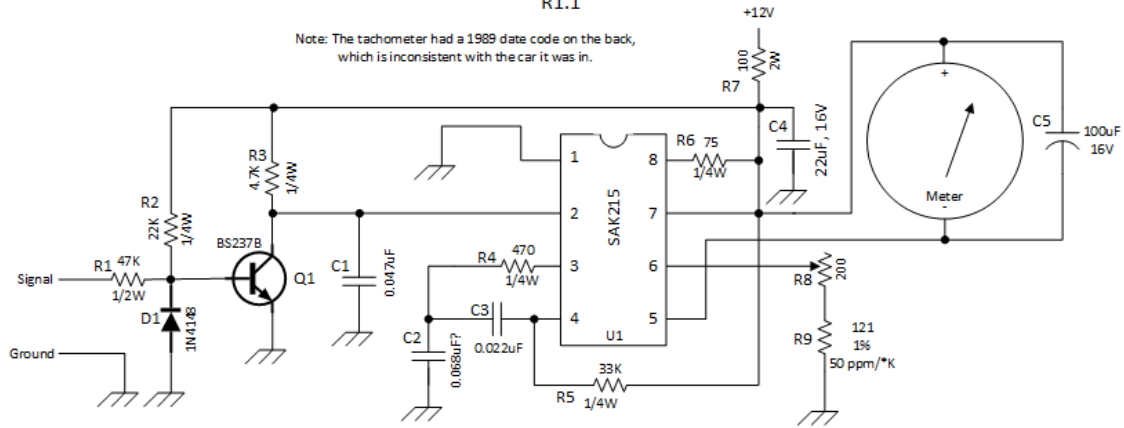


I removed the nuts, flat washers and lugs from all three terminals and the two white insulating washers from the power and signal terminals. The tachometer innards came out of the case and I removed all three of the black insulating washers from the tops of the terminal standoffs.



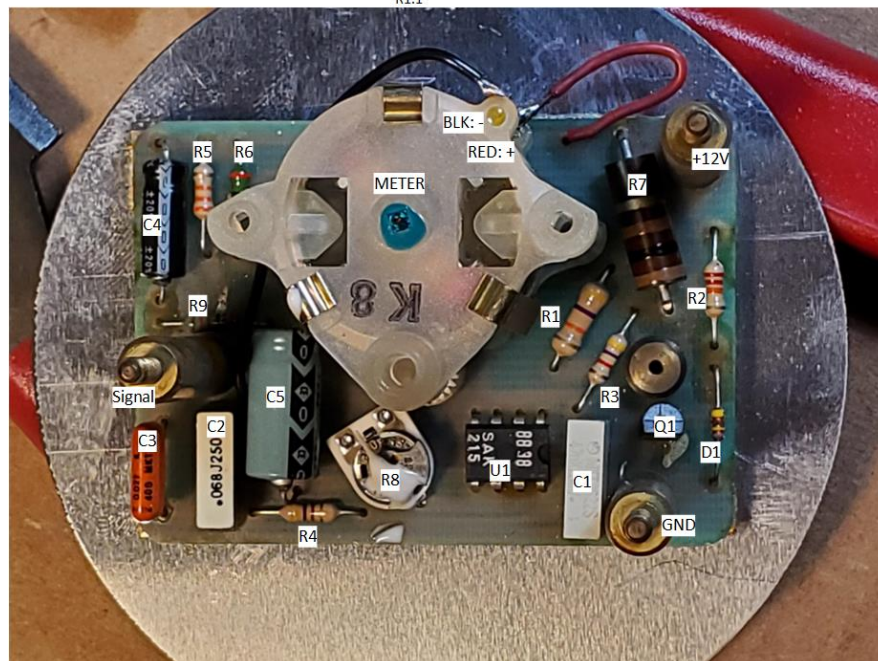
This gave me access to the PCB so that I could reverse engineer the circuit:

1987 Lamborghini Jalpa Tachometer Schematics
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Here are the component locations on the PCB:

1987 Lamborghini Jalpa Tachometer Component Locations
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One interesting thing I learned during the reverse engineering process is that the tachometer face is electrically connected to the tachometer input signal due to a screw that holds the face to the end of the input signal standoff post.

The input circuit makes it obvious why the tachometer does not work with the MSD ignition or with my bench setup with 0 to 12V calibration pulses. The SAK 215 integrated circuit is triggered by a positive pulse on its input. But the Bosch ignition module puts out a negative voltage pulse, so a transistor was added to invert that negative voltage system. With no signal on the tachometer input, R2 pulls the voltage on the base of the transistor up, which turns Q1 on. When Q1 is on, the input to the SAK215 is pulled to ground. To generate a positive input to the SAK215, the transistor base must be pulled to about 0V to turn it off. With the transistor off, R3 pulls the SAK215 input up to its regulated 7.4 to 8.2V, triggering the tachometer.

To get the base of the transistor down to about 0V, the input of the tachometer needs to be pulled down to at least -15V, worst case to at least -17.5V. This is due to the voltage divider formed by R1 and R2 from the SAK215 regulated voltage.

This explains why the 0 to 12V signal from the MSD ignition system and my bench setup did not trigger the tachometer.

When I set my function generator to its maximum amplitude of 15V and minimized the offset, the signal was 0 to -15V and my bench setup was able to trigger the tachometer successfully. When the tachometer is successfully triggered, the SAK215 drives current through the ammeter. The higher the tachometer signal frequency, the higher the average current goes through the ammeter.

It is interesting to note that the ammeter is a 90 degree ammeter but the needle on the face travels a lot more than 180 degrees. This is accomplished by a pair of gears that allow the meter to drive the needle with longer travel.

While this car has the Bosch 0227300002 ignition module, it is likely that similar vintage vehicles with Bosch 022730000x modules will have tachometers with similar negative trigger voltage tachometers such as this one. This could possibly include some vehicles from Porsche, Maserati, Ferrari, Mercedes, BMW and Alfa Romeo and maybe others.

In order to make a tachometer like this one work with a 0-12V tach signal, either the tachometer input circuit has to have the transistor removed from the circuit and a new input protection circuit added or an external tachometer adapter needs to be designed. AccuTach Co. now offers an adapter called the Lambo Tach Signal Inverter. Visit www.accutach.com to learn more.