Sun ST-601 Electronic Tachometer Analysis

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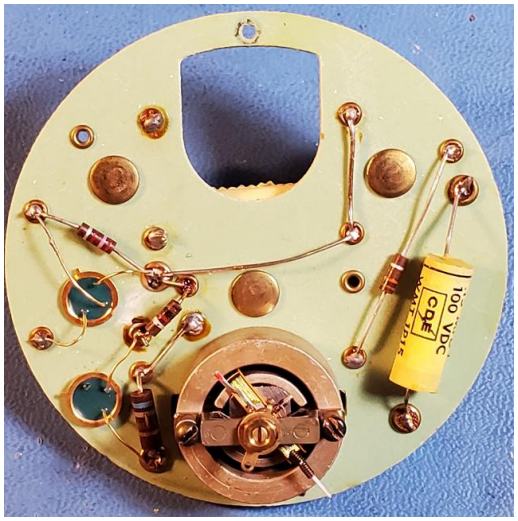
Rev. 1.2

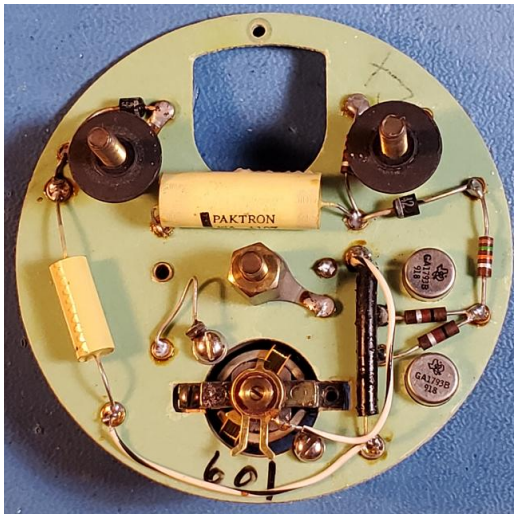
I received a non-functional Sun ST-601 tachometer from a customer for me to reverse engineer.
(A reader has told me that the ST-603 tachometer has the same circuit.)

In order to gain access to the electronics, the chrome bezel must be uncrimped:

After the bezel has been removed the tachometer innards can be removed by removing the nuts on the power terminal, the trigger input terminal and on the stud at the center of the nameplate. Then, removal of three screws allows the tachometer face to be removed, exposing top side of the PCB.

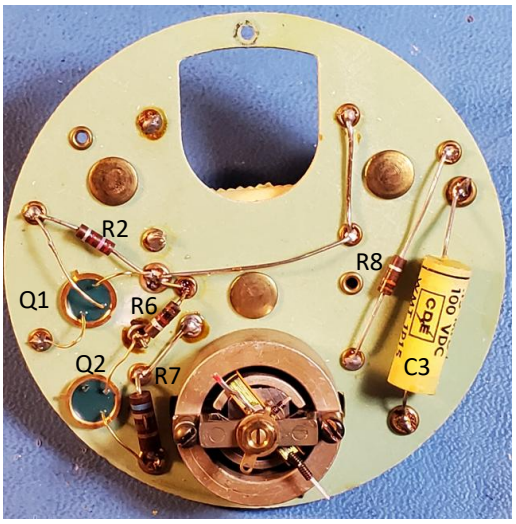


PCB Top

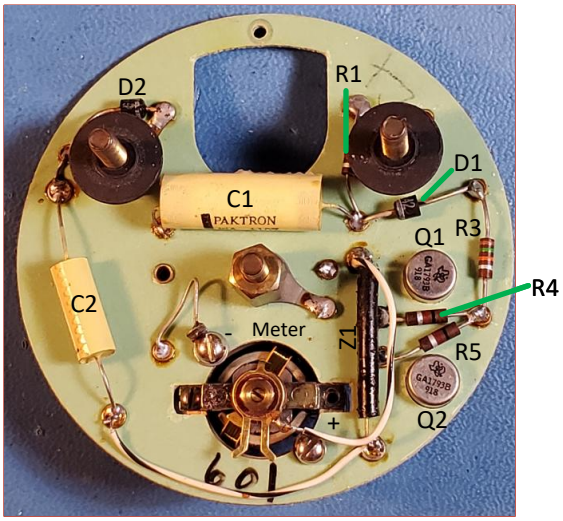


PCB Bottom

Here are the component designators for the components on the front and the rear of the PCB.

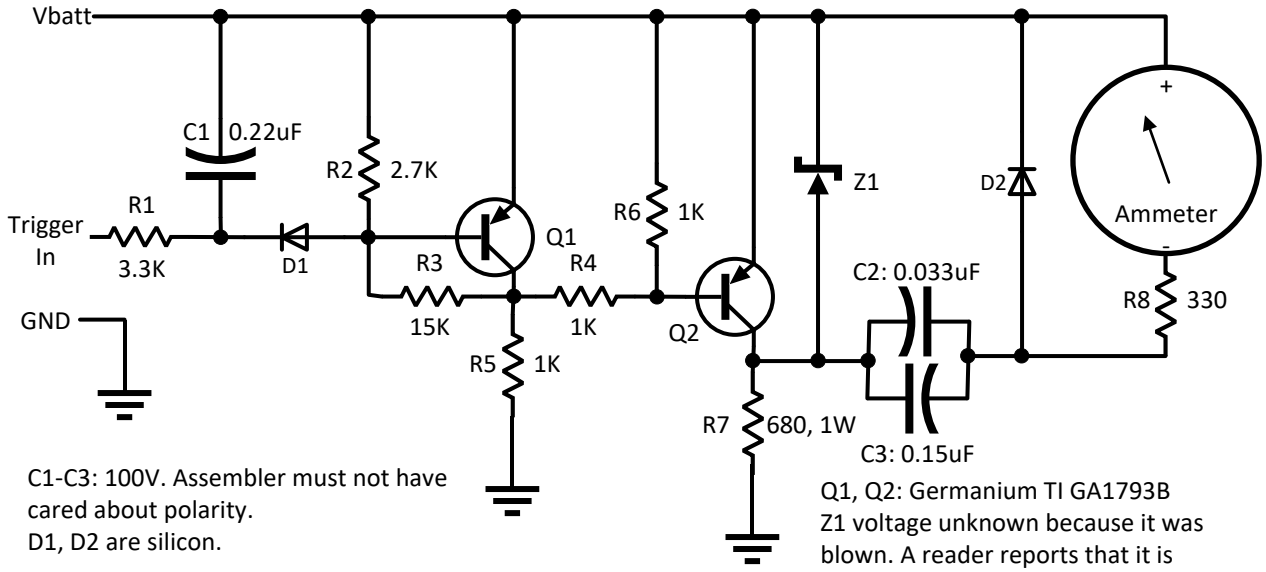


Top



Bottom

SUN ST-601 Tachometer Schematics



C1-C3: 100V. Assembler must not have cared about polarity.
D1, D2 are silicon.

Q1, Q2: Germanium TI GA1793B
Z1 voltage unknown because it was blown. A reader reports that it is about 12V.
All resistors are 1/4W except R7.

The tachometer had a broken needle, a broken hairspring and was missing a bearing support screw so it was impossible to characterize the ammeter. Z1 was open as was Q2. The Q2 emitter lead was completely burned up, leaving a scorch mark on the PCB. As a result, the Zener voltage is currently unknown.

Theory of operation

R1 protects D1 by limiting its current. R1 and C1 form a 220Hz low pass filter that filters out any high frequency noise in the ignition signal.

Whan the points are open, the Trigger In signal is typically at 12V (or above with coil ringing.) Not enough current flows out of the base of Q1 to turn it on, so R4 and R5 draw enough current out of the base of Q2 to turn it on. With Q2 on, the collector goes to battery voltage. Any charge in C2/C3 will cause the voltage on the other side of them to go above battery voltage, only to be completely discharged by D2 so it will not go through the ammeter the wrong way.

When the points close, enough current can flow from the base of Q1 to turn it on. The collector of Q1 pulls the base of Q2 up to battery voltage, turning Q2 off. That allows C2/C3 to charge to battery voltage minus Zener voltage through R7 and the ammeter causing the needle to deflect.

If anyone has an ST-601 with a functional Zener diode, please measure it with the Trigger In grounded and share it with me so I can add it to this document. The resistance of the ammeter would also be a good thing to measure and add to this document.