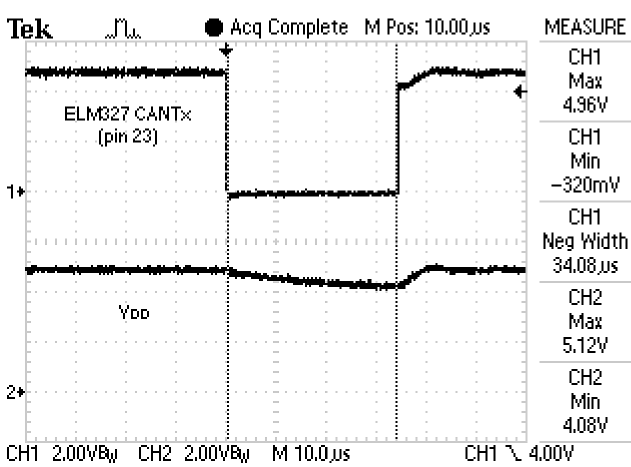
AN03 - ELM327 Low Voltage Resets

The base processor that is used for the ELM327 has very strict supply voltage requirements. It may possibly be able to operate at voltages lower than these, but the results could be very unpredictable, and likely not reliable. For this reason, the ELM327 has always used what is known as a 'brownout detector' to detect when the V_{DD} voltage is below the acceptable limit (4.3V), and to reset the IC if it is.

Prior to version 1.3, the ELM327 would simply perform a reset on a low voltage condition, then print the startup message, etc. as if the power had been turned off and on. This response could be quite confusing - was it a software 'glitch' or something else causing the reset? As of v1.3, the ELM327 now prints 'LV RESET' if a low voltage reset has occurred.

Low voltages to the ELM327 can be a result of many things. Problems while constructing the circuit such as component failures, or wiring errors can be one cause. Once a circuit is built and tested, there can be other issues that result in a low voltage condition – problems with the supply from the vehicle, or issues with the vehicle wiring, to name a few.

Should a problem result in a large current flow, voltage regulators (such as the 78L05) will usually go into a current limiting state, to protect itself as well as the load circuit. This causes the output voltage to drop (as there isn't enough current to maintain the desired voltage). A short circuit from the CANH output of the CAN transceiver to circuit common is one type of wiring problem that would cause such a current limiting condition. The trace below shows what typically happens to the V_{DD} voltage when the CANH output is shorted to circuit common:



From this trace, it seems that the ELM327 CANTx output is stopped because of the low voltage brownout condition. This is only a coincidence however, as the ELM327 will abort any send after about 34 µsec if it detects a problem. If we could somehow supply the CANH current for this short time, without causing a low voltage (brownout) to occur, then the ELM327 would have time to abort the send and stop the current for us. Users of the circuit would likely not even be aware of this CANH problem, as there would be no LV RESET to alert them. One way to allow large currents for a short time is through the use of capacitors on the supply (V_{DD}).

To determine the size of the capacitor required, we first need to know how much current it needs to supply. The MCP2551 transceiver data sheet states that a CANH short circuit current is limited to 200 mA, and we know that a 78L05 is able to provide about 100 mA, so the capacitor must supply the difference, or 100 mA. It needs to do this for the 34 µsec, and the 5V supply can not drop below 4.3V during this time. Using that information in the capacitor formula, we can determine the total capacitance required:

$$\text{Since } I = C\,\frac{\Delta V}{\Delta t} \quad \text{then } C = I\,\frac{\Delta t}{\Delta V}$$

$$C = 0.1\,\frac{34 \times 10\text{E-}06}{(5.0 - 4.3)}$$

$$C = 4.9\ \mu\text{F}$$

Testing proves that connecting a 4.7 µF capacitor across C7 (in Figure 9 of the data sheet) will almost eliminate the LV RESETs due to CANH short circuits, but they may still occasionally occur. For a more reliable solution, you may want to try a larger (ie 10 µF) capacitor.

What about the regulator itself? Can it be replaced with one that is more capable? Yes. Testing has shown that a standard 7805 regulator is more than capable of supplying the current needed for a brief CANH short circuit. It could also allow enough current to damage circuit components though, especially if the transceiver circuit that you use does not limit the bus short circuit currents. The decision to use a larger regulator should be considered carefully.

In summary then, if you are seeing occasional 'LV RESET's and wish to reduce if not eliminate them, you may wish to consider adding about 10 µF of capacitance on the 5V supply, or possibly using a voltage regulator with a higher current rating.