

Motorized VB Valve Drive LRAUV

22 Mar 12 ecm

Requirements:

1. Input power 10-24 VDC, switched by LCB
2. Drive Maxon 221024 motor plus 110340 gear (370:1)

5V nom, 2.2 ohm winding
2.3A stall current @ 5V
0.6A run current @ predicted valve load (Jon's analysis 4/11/2011)
0.8A max continuous current (Maxon spec, thermal limit)
predicted quarter turn time 1.3 sec @ 5V with predicted valve load
3. Accept input command from EZServo 'On/Off' output. (switched Battery voltage)
Level triggered:

"Off" --> Close Valve (also EZServo power down state, and initialized state after POR)
"On" --> Open Valve
4. Close valve automatically, using stored energy, if power fails. (Worst case is immediately after opening.)
5. Accept input from PSW-500 pressure switch. Force valve to Closed state, and do not allow Open command, below switch actuation depth.

Additional Features:

6. "Ready" output when enough energy is stored for operation and all supplies are within tolerance.
7. "Closed/Open" output to verify valve position

Approach:

1. Micropower DC-DC charges supercapacitor to ~5V
2. Motor Drive runs on 5V. H-Bridge controls motor Forward and Reverse motion. Micropower Idle state. UV Lockout below 2.3V. Output current limit 2.8A. Possible soft-start ramp. Braking function not implemented, motor coasts to stop.
3. Magnets on valve shaft trigger Hall sensors on Drive Board. Hall sensor feedback terminates movement at either end of valve travel, also generates Closed/Open output signal.
4. Discrete logic combines input and feedback signals, generates motor Fwd/Rev commands.
5. DC-DC is current limited to 0.6A. This allows motor to run at predicted torque indefinitely without discharging supercap, or stall indefinitely without overheating. 0.6A will take 21 seconds to charge supercap (2.5F) from 0 to 5V during a cold start.

6. Typical 1/4-turn move takes 1.3 seconds at 0.6A (Jon's prediction). This runs supercap down by 0.3V. Worst-case 1/4-turn move takes 2 seconds at 1.0 A (Ed's WAG). This runs supercap down by 0.8V. Stall takes 2.3A, supercap discharges to 1.3V with RC time constant of 5.5 seconds.
7. Voltage Monitor/Supervisor generates Undervolt signal if input power is <10V, motor power is <4.5V, or housekeeping power is <3V. An undervolt on any bus drives the motor towards the Closed position, and de-asserts the Ready signal.
8. "Ready" output status signal is asserted when all supplies are above minimum limits, and valve position agrees with commanded position.
9. Micropower low-dropout (LDO) linear regulator generates 3.3V logic supply, from either the input power (10-24V) or the 5V motor power (diode-OR).
10. With input power removed, all logic circuits will remain powered by 5V bus from supercap. Current drain at room temperature or below should be 20-30uA. Supercap will supply this current for about 8 hours before discharging to 4.5V undervolt threshold, thus should be instantly ready for action if VB has been used anytime in previous 8 hours.