

Motor Driver ICs Faults and Protection

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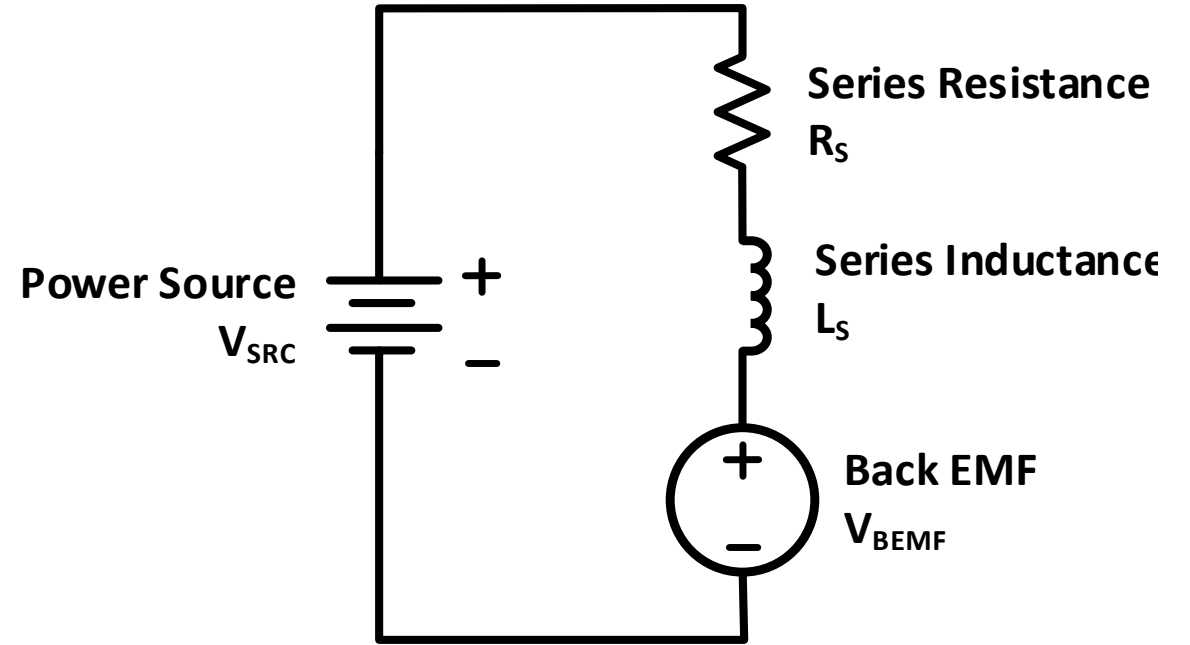
Aug. 2021



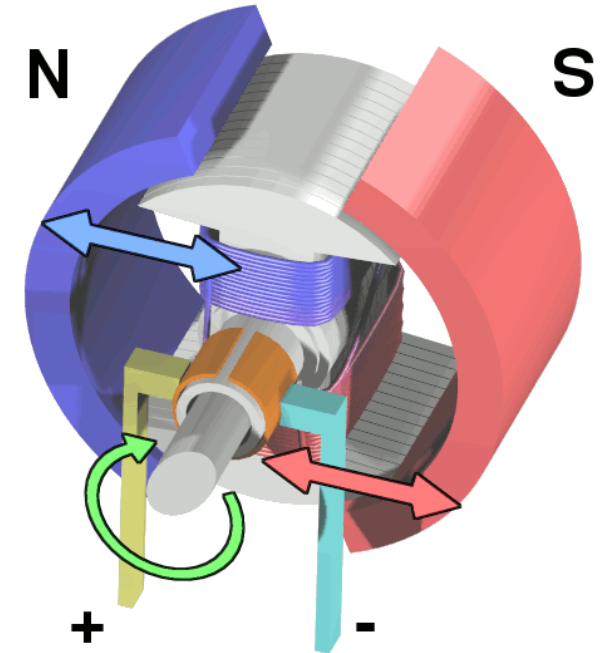
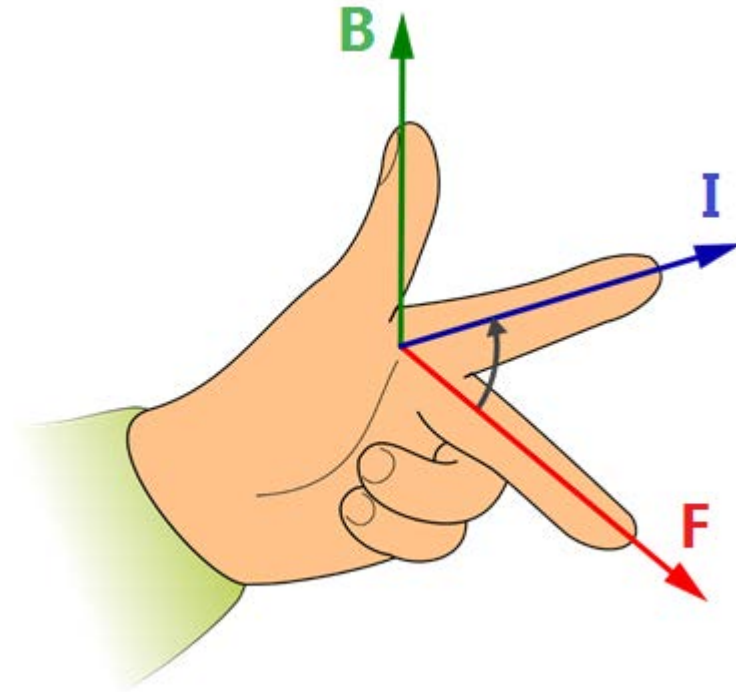
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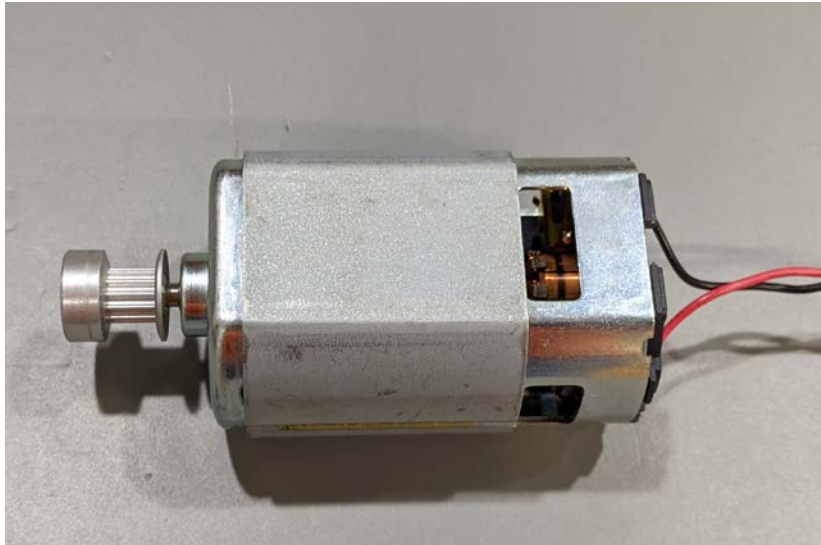
DC Motor Basics



Torque and Current

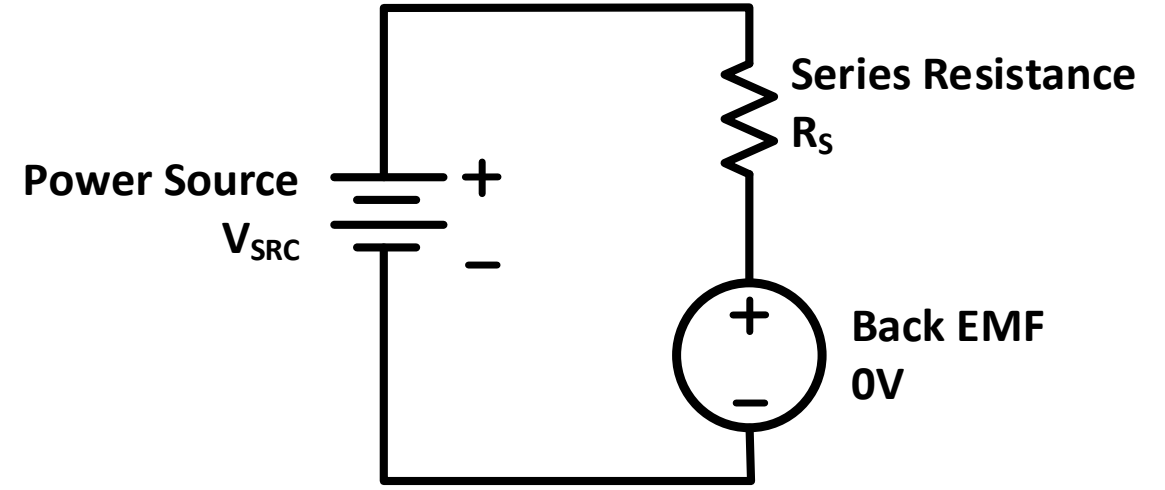
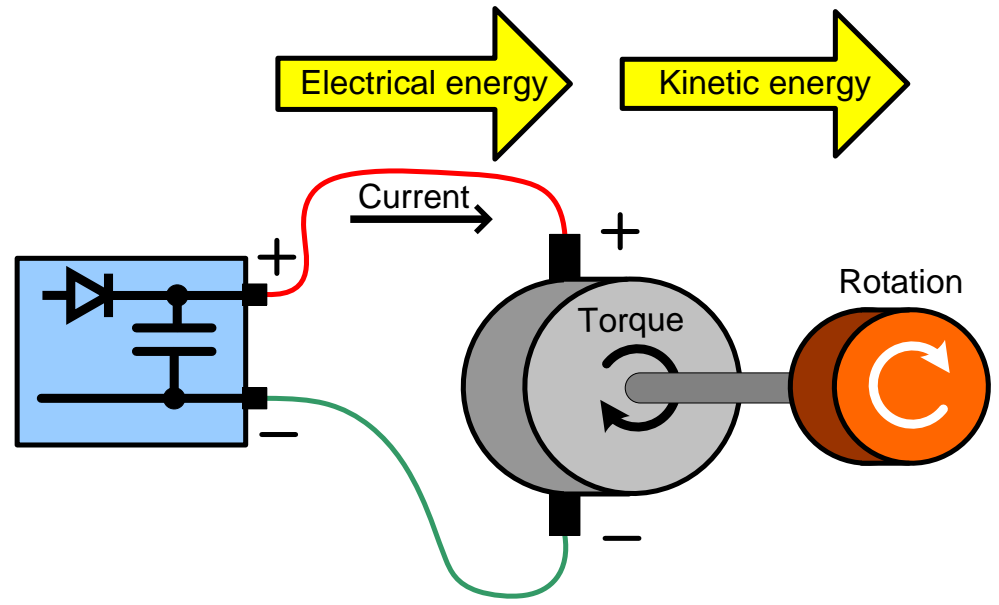


DC Motor Specs and Ratings



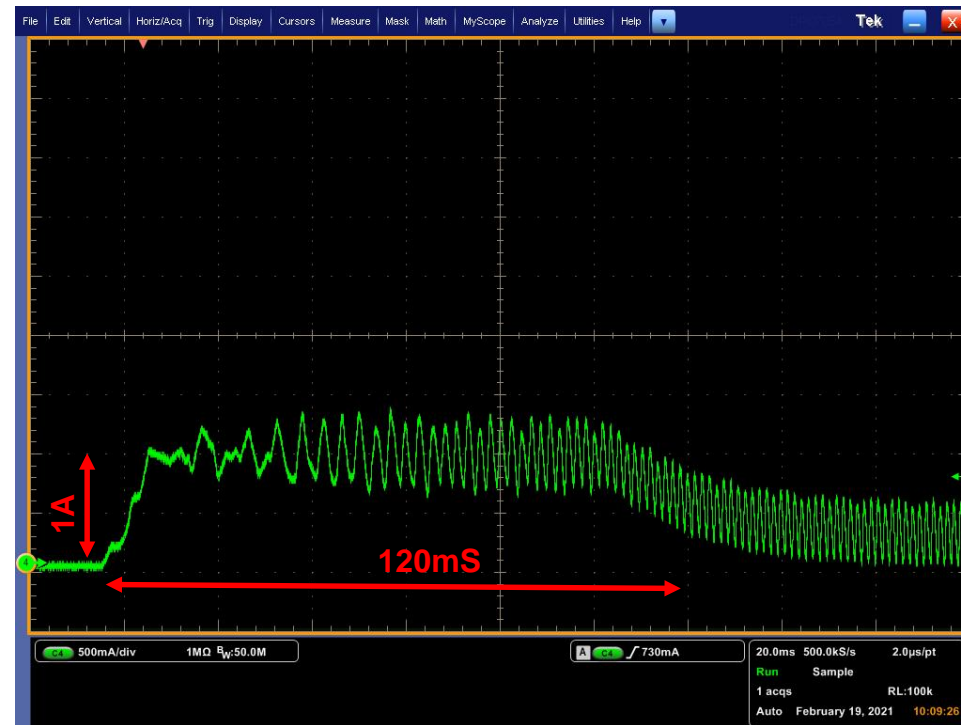
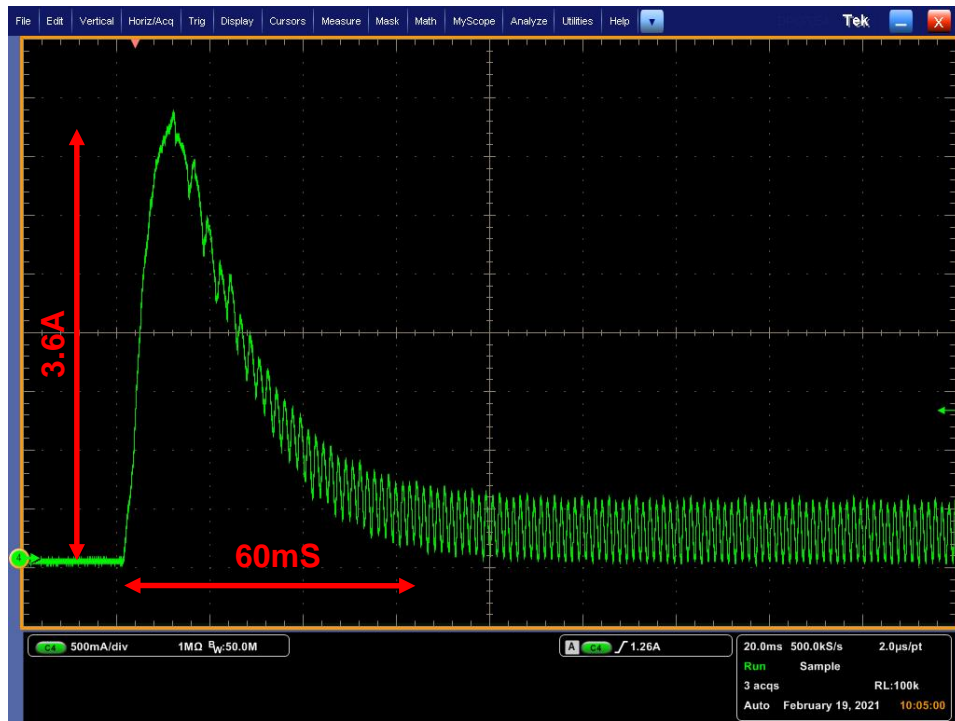
Output Power	15	Watts
Nominal Voltage (V_{SRC})	24	Volts
No Load Speed	4000	RPM
No Load Current	0.11	Amps
Full Load Speed	2920	RPM
Full Load Continuous Torque	50	mNm
Full Load Continuous Current	1	A
Stall Torque	190	nMn
Stall Current	3.6	Amps
Resistance (R_s)	6.7	Ω

Startup of a DC Motor

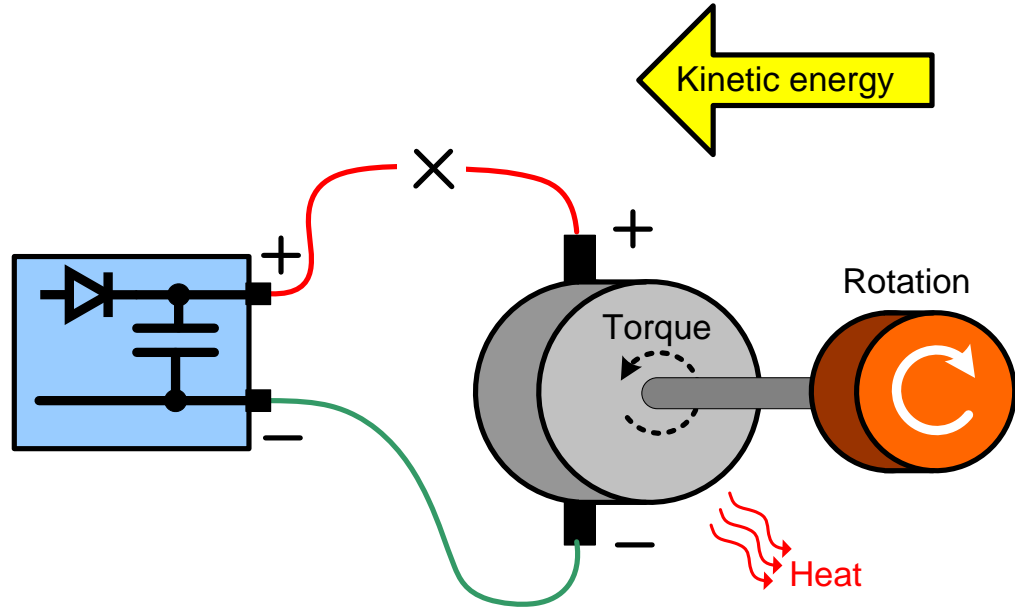


When speed = 0:
$$I = V_{SRC} / R_S$$

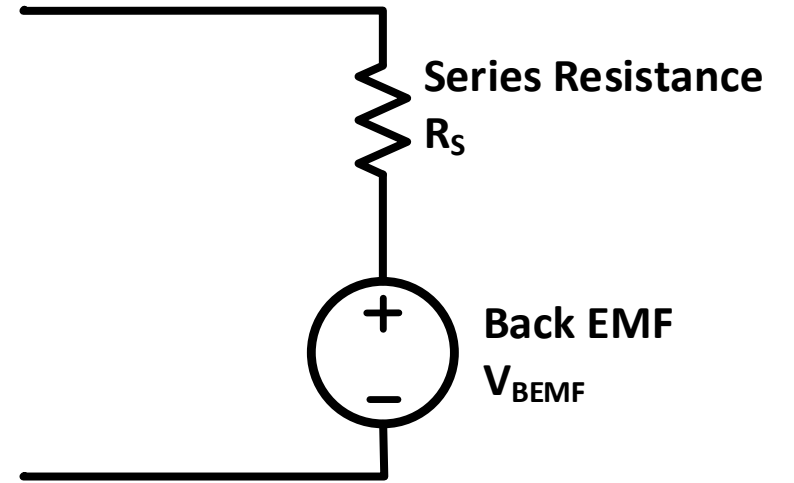
Managing Startup Current



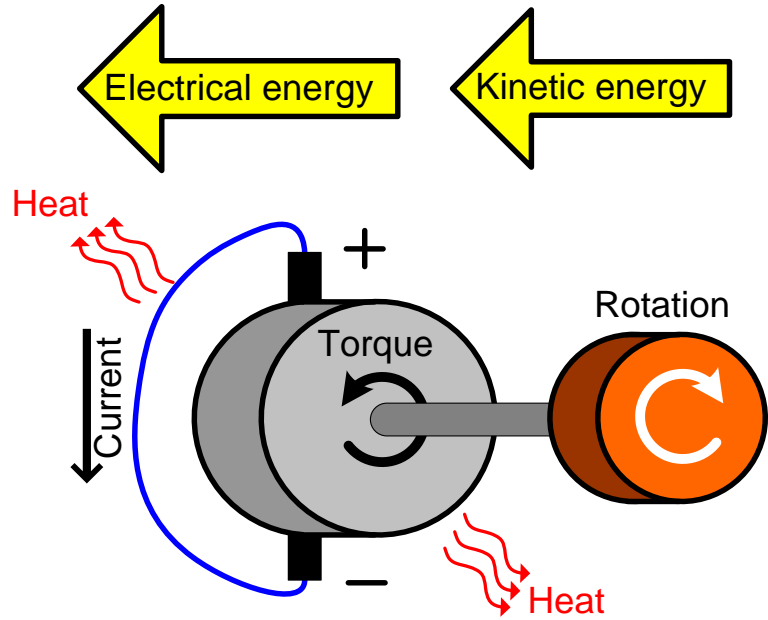
Stopping the Motor: Coasting



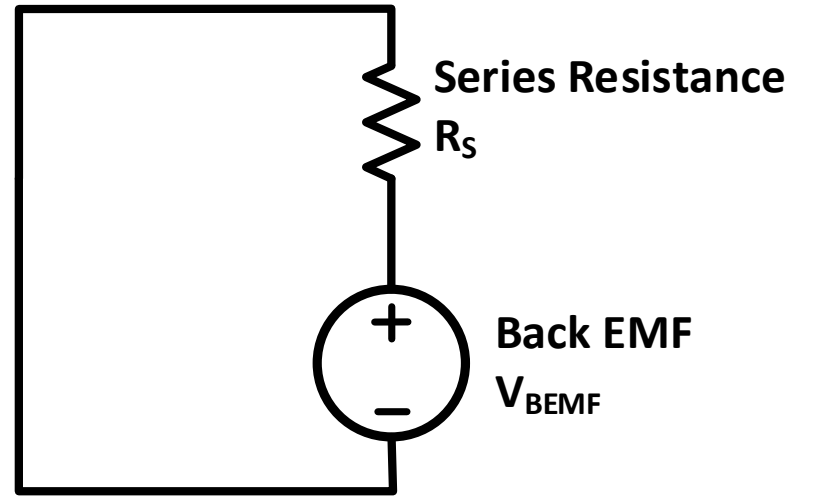
Coast
 $I = 0$



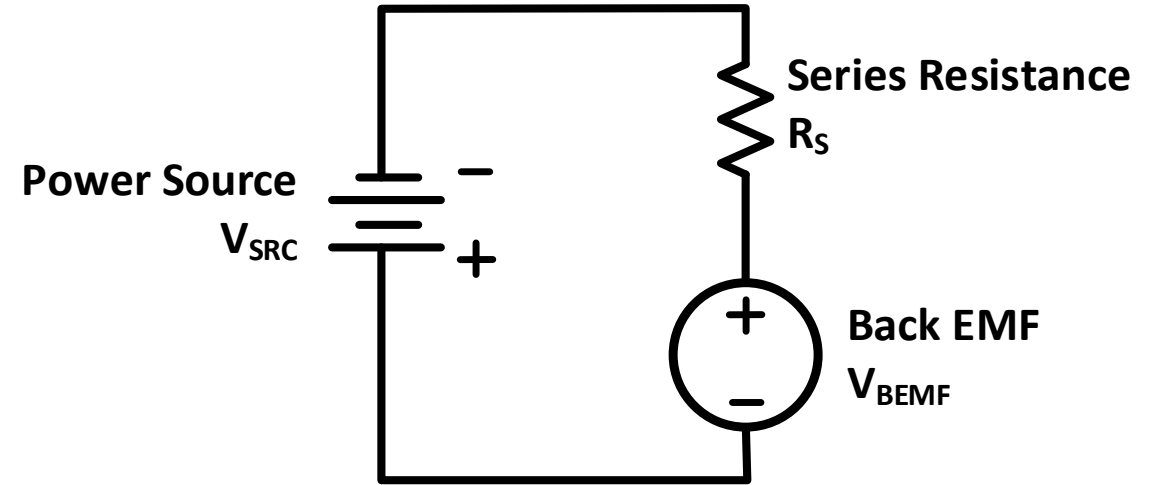
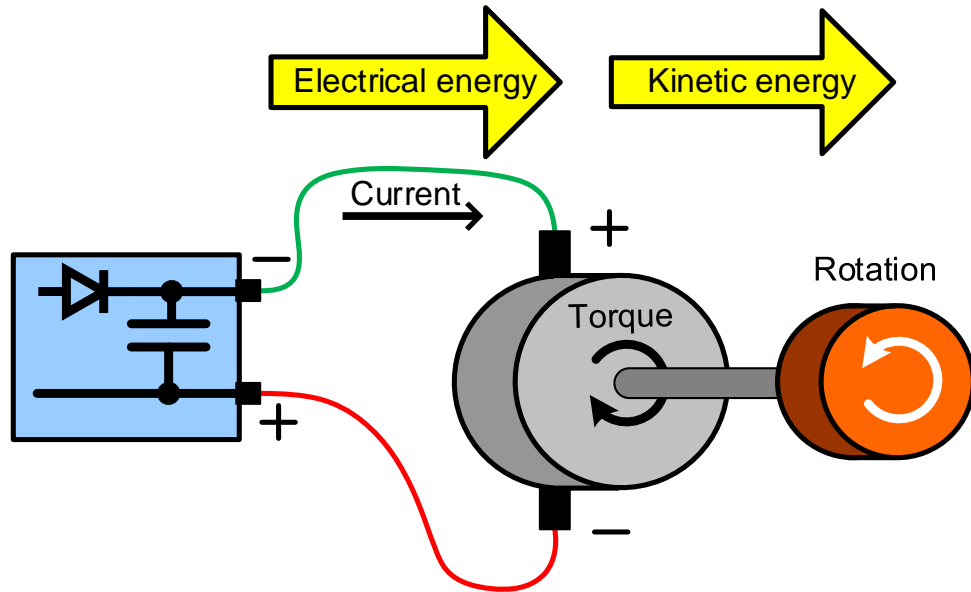
Stopping the Motor: Braking



Short Brake
 $I = V_{SRC} / R_S$



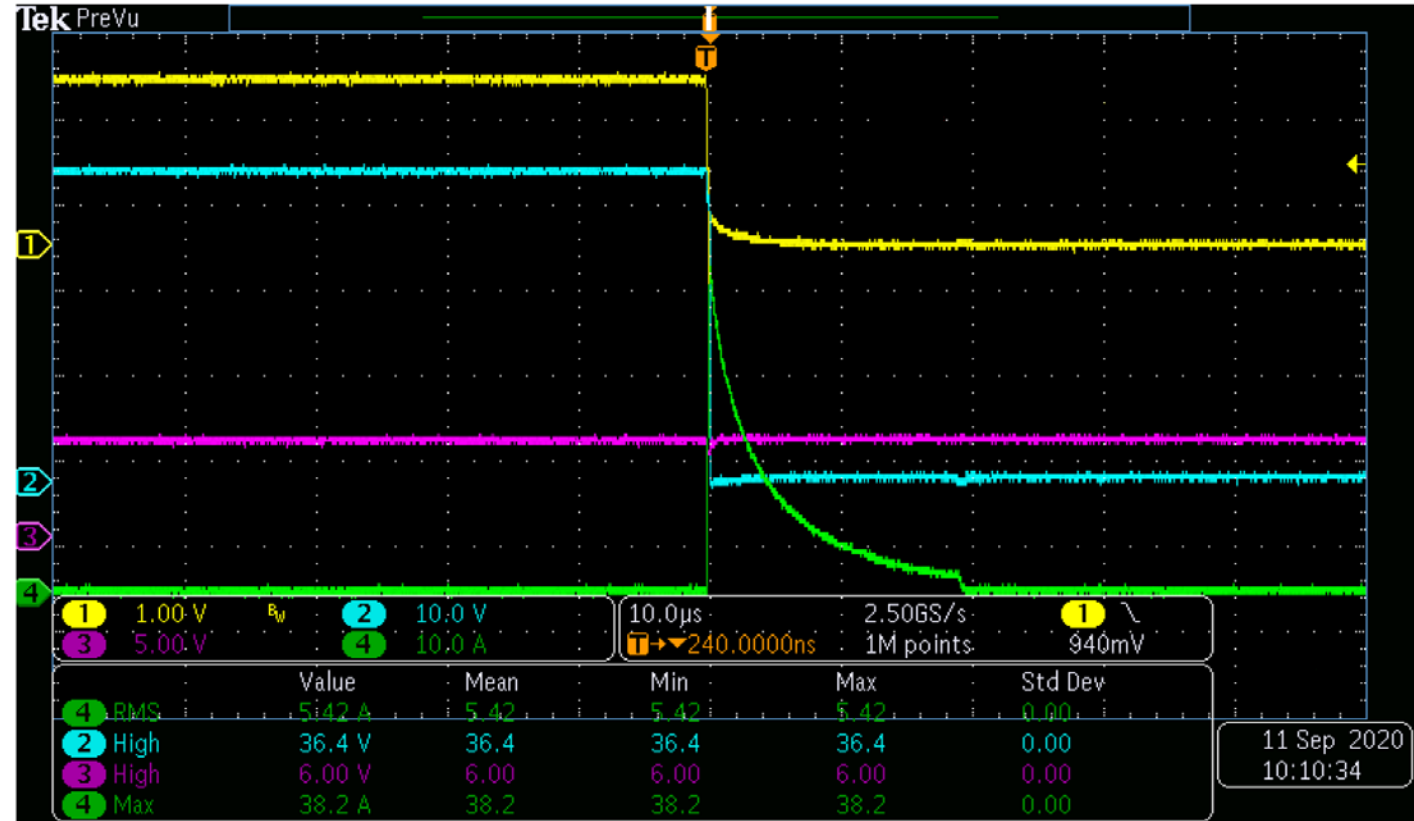
Reversing the Motor



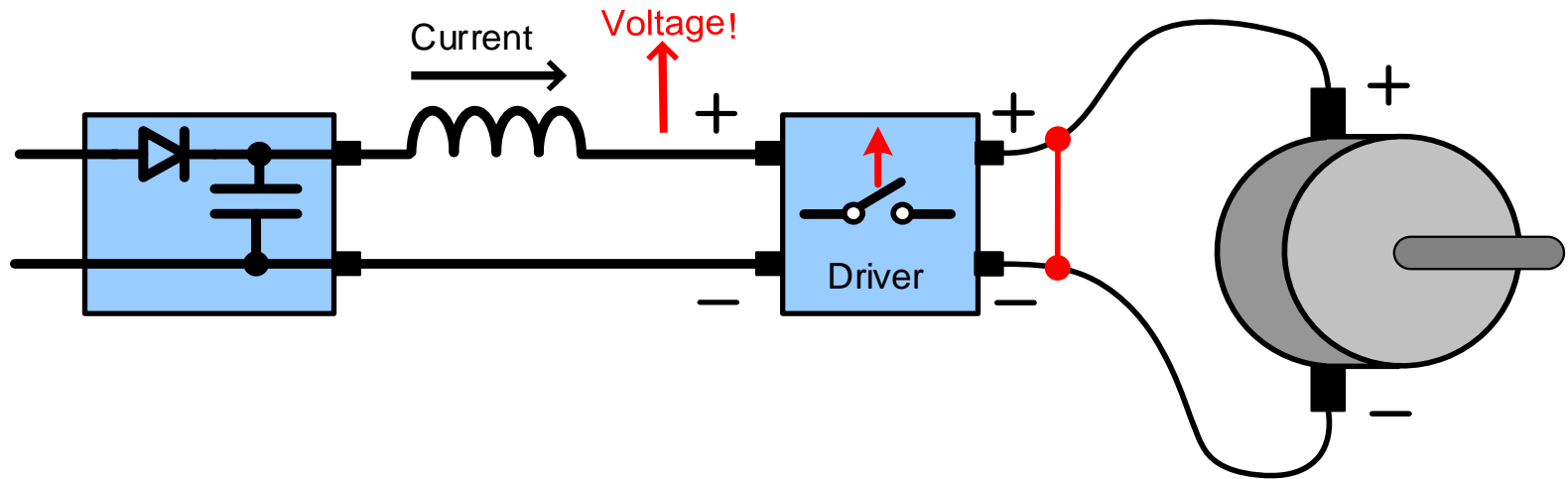
Reverse

$$I = (V_{BEMF} + V_{SRC}) / R_S$$
$$= \sim 2 * V_{SRC} / R_S$$

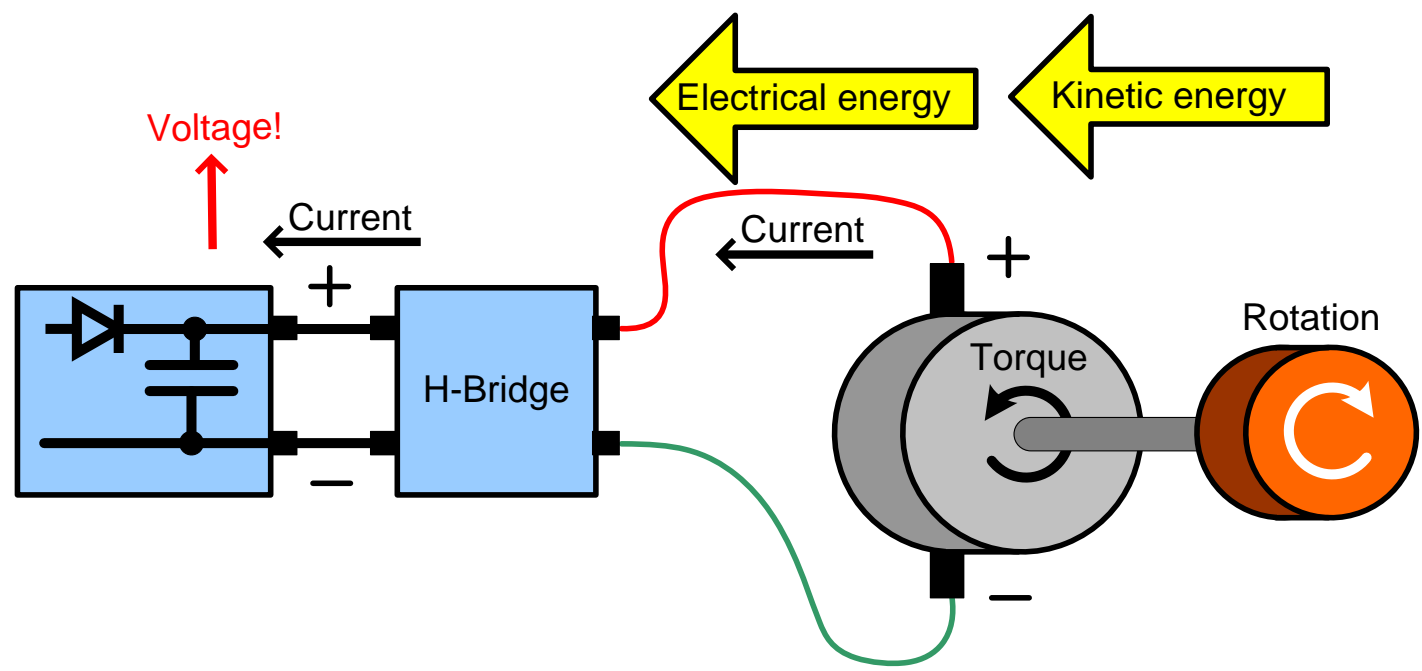
Short Circuits



Voltage Stresses



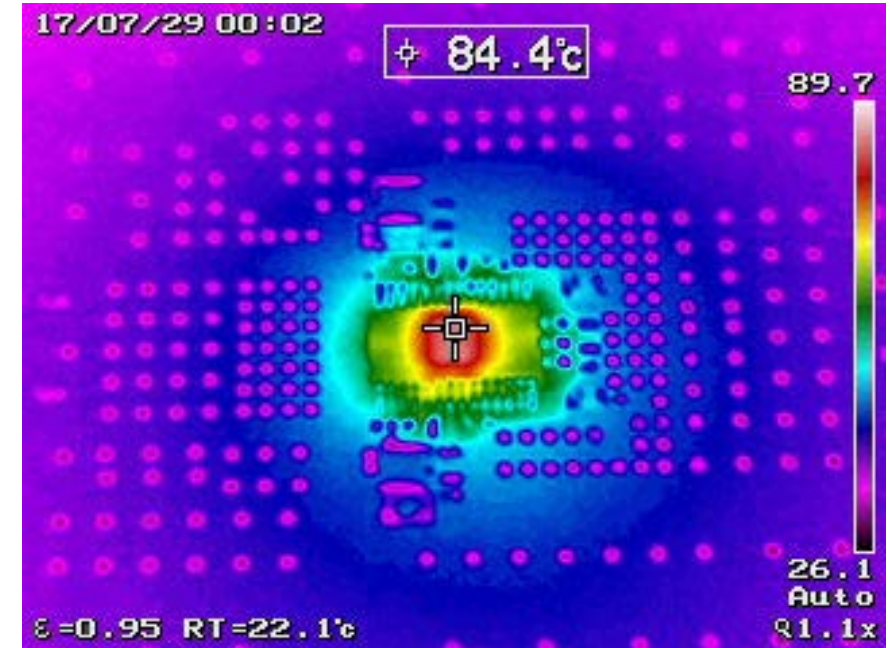
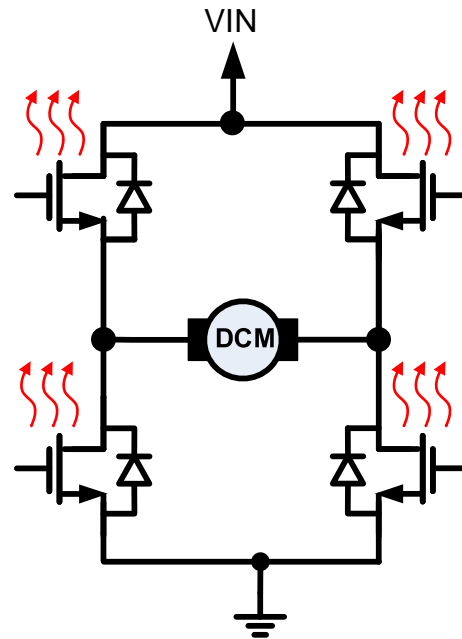
Voltage Rise due to Deceleration



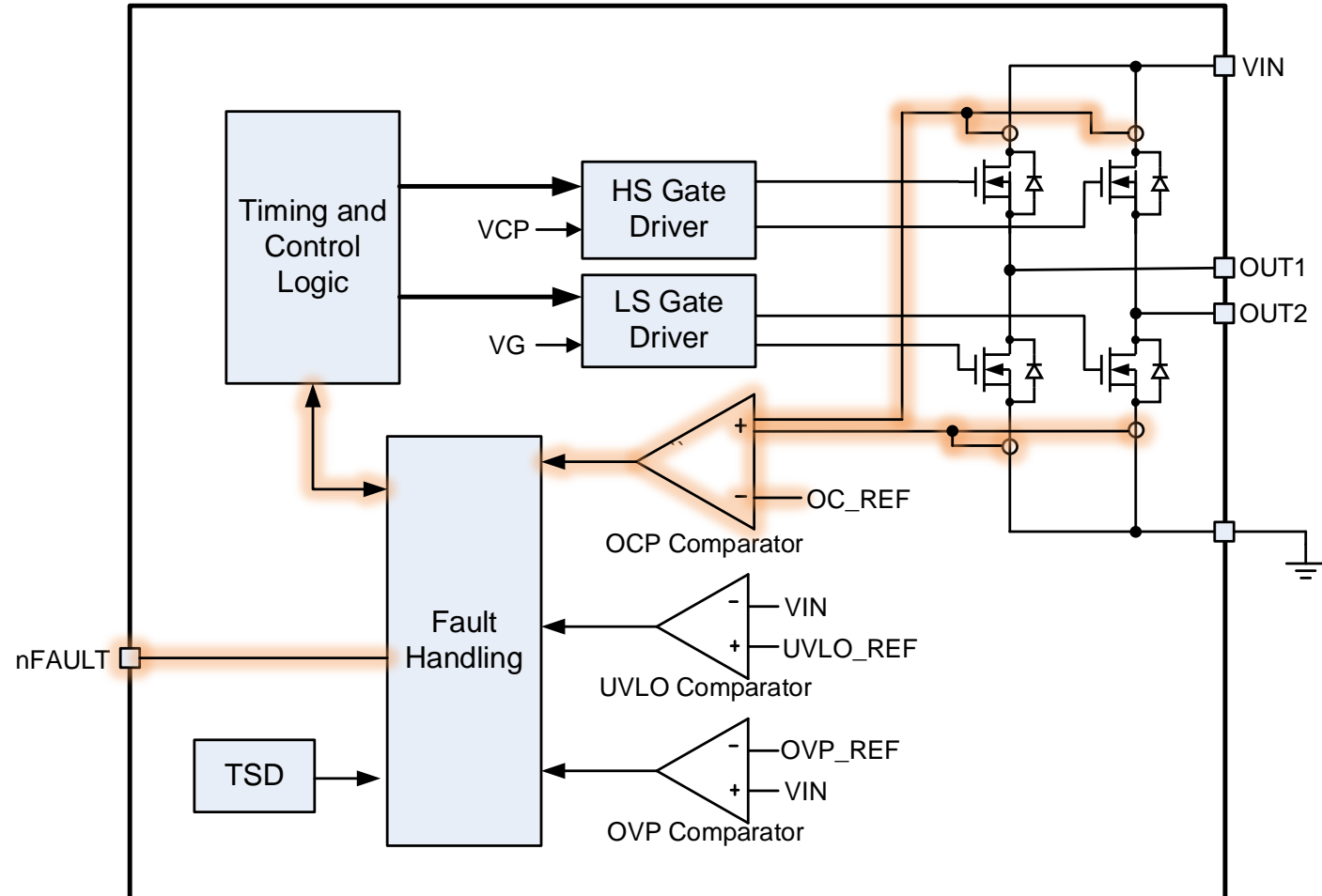
Thermal Stresses

Resistive Losses

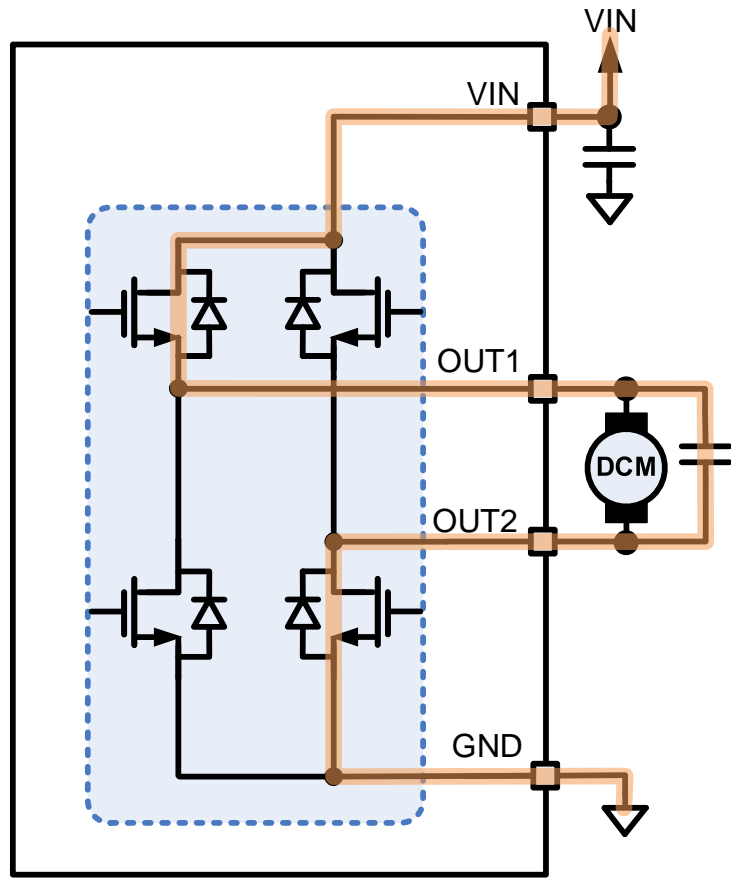
$$P_R = I^2R$$



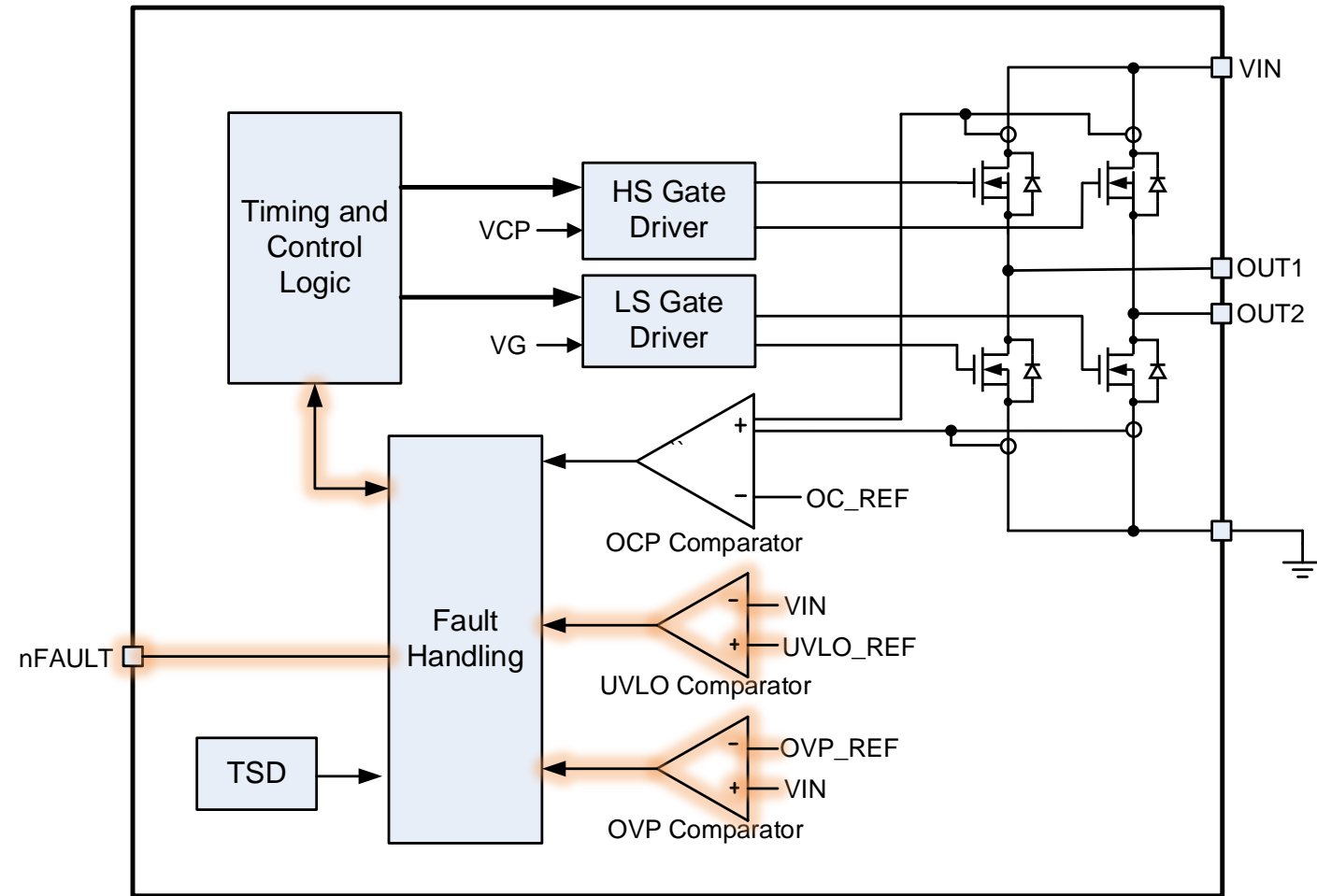
Motor Driver Protection Features: Overcurrent / Short Circuit



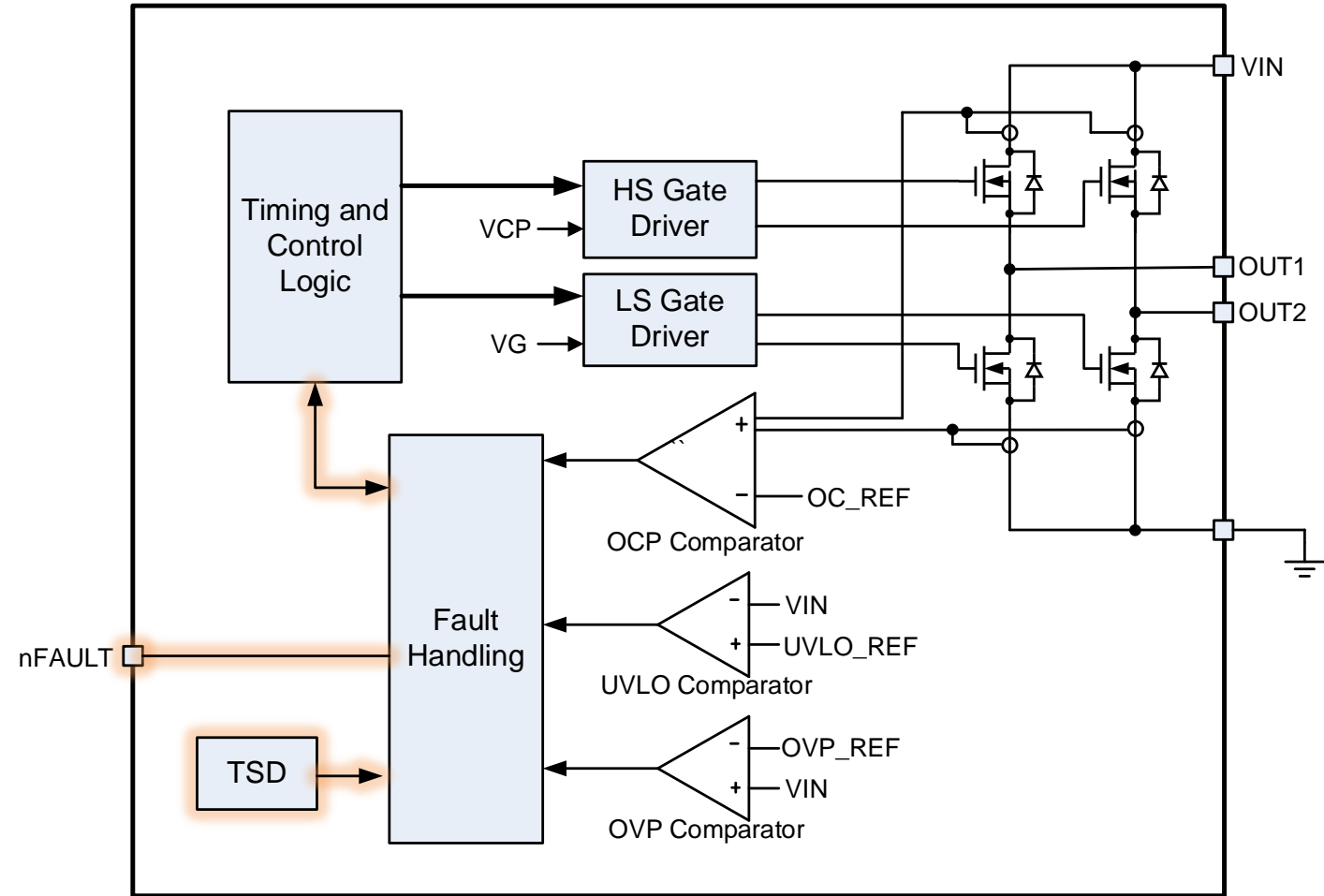
False Overcurrent Trips



Motor Driver Protection Features: Over/Under Voltage



Motor Driver Protection Features: Thermal Protection



Summary

- Consider the stresses in a motor drive circuit when starting, stopping, and reversing the motor
- Minimize power supply inductance
- Add clamp circuits and large bulk capacitors to mitigate voltage transients
- Be aware of heat dissipated in a motor driver, especially during abnormal conditions