

# Closed Loop Analog Position Control using Brushed DC Motor and Potentiometer

The project presented here is a low-cost position control closed-loop analog-servo using brushed DC motor and potentiometer as feedback. This project provides all necessary active functions for a closed-loop servo system using a Brushed DC Motor and potentiometer mounted on the output shaft of the DC Motor with Gear. The project is ideally suited for almost any servo positioning application. Can be used in applications such as side mirror movement control for cars, car head lamp beam control, animatronics, robotics, etc.

The project requires a special mechanism, where the DC motor's output shaft is mechanically couple with the potentiometer shaft using a reduction gear. Approx. reduction ratio 15-50: 1. When the reference pot is turned, the motor shaft will follow the potion. This will provide a maximum rotation of 270 degrees. Multi rotation is possible with the help of a multiturn potentiometer.

The project is based on **ZXBM5409Q** chip from diode incorporation which is a protected H-bridge driver designed specifically for manual automotive headlightbeam control and industrial servo control applications with DC-brush motor loads. The integrated full-bridge driver output stage is composed of high-current, low-RDSON H-bridge MOSFETs to maximize efficiency. To simplify the circuit design and minimize external components, the device integrates voltage and temperaturecompensated internal references, amplifiers, and output H-bridge power switches with low RDSON. For system flexibility, the servo control forward and reverse hysteresis, dead band, and angle amplification are easily programmable by external resistors. To help protect the motor coil, the ZXBM5409Q provides fault condition protection, such as RANGE input short to GND, short-to supply voltage, or broken wires, by stopping the motor and disconnecting the output stage. In case of supply undervoltage and overvoltage, the device shuts down the output drive to help prevent overvoltage stress on the coil. The overcurrent protection monitors the output current and shuts down the outputs stage with periodic retry to help protect the coil from device burnout. Overtemperature shutdown provides thermal protection for the device.

*Note:* Read the data sheet to learn more about defining the hysteresis window, it advisable to solder a0.1uF capacitor across the motor +/- terminal for noise decoupling.

## Features

- Wide Operating Voltage Range: 8V to 18V
- Output Current 800mA (Peak 1.6Amps)
- Fault Protection—RANGE Short to GND, Supply or Broken Wires
- Overvoltage and Undervoltage Shutdown
- Overcurrent Protection
- Thermal Protection
- PCB dimensions: 36.04 x 26.51 mm







# Thermal Shutdown Protection

The device has an internal thermal shutdown to prevent a thermal runaway scenario. The thermal shutdown is triggered when the junction temperature of the device reaches +170°C. It will remain in standby mode until the junction temperature falls by +30°C.

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### **Overcurrent Protection**

The internal overcurrent protection (OCP) threshold is 1.6A typical at 12V supply +25°C. When the motor current exceeds the OCP threshold for longer than 2µs typical on any of the H-bridge switches, the device switches off all the output switches and remains off for 5ms typical. The IC returns to normal operation after the 200µs if overcurrent condition goes away. If the motor current is still higher than the OCP threshold, the device enters another 5ms standby mode.

#### Overvoltage Shutdown of Output Drive

When the supply voltage exceeds the overvoltage shutdown threshold, VOV\_TH, the ZXBM5409Q shuts down all the output drive switches and enters standby mode to help prevent overvoltage stress on the coil. The driver returns to normal condition if the supply voltage drops below VOV\_RLTH—provided no other fault condition or signals are preventing it from entering normal operation

#### Undervoltage Lockout

To make sure the minimum voltage required to operate the driver is supplied, the ZXBM5409Q has an undervoltage lockout. At start up the device only starts if the supply voltage is typically over VUVLO\_RLTH. During normal operation, the device switches off all the output switches and powers down if the supply voltage drops below VUVLO\_TH typical. When the supply voltage drops below undervoltage lockout threshold, VUVLO\_TH\_R, the ZXBM5409Q shuts down all the output drive switches and enters standby mode to help prevent overvoltage stress on the coil.













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#### PCB DIMENSIONS 36.04MM X 26.51MM

BOM						
NO	QNTY	REF	DESC	MANUFACTURER	SUPPLIER	SUPPLIER PART NO
1	1	CN1	4 PIN MALE HEADER PITCH 2.54MM	WURTH		732-5317-ND
2	1	CN2	4 PIN MALE HEADER PITCH 2.54MM	WURTH		732-5317-ND
3	1	C1	0.1uF/50V SMD SIZE 0805	MURATA/YAGEO		
4	1	C2	DNP			
5	1	C3	100uF/25V ELECTROLYTIC	RUBYCON	DIGIKEY	1189-4162-3-ND
6	1	D1	1N4007 SMD	SMC DIODE	DIGIKEY	1655-1N4007FLCT-ND
7	5	R1,R3,R4,R6,R7	42K 1% SMD SIZE 0805	MURATA/YAGEO	DIGIKEY	
8	2	R2,R5	5K POTENTIOMETER	BOURNS	DIGIKEY	PDB181-P415K-103B-ND
9	1	U1	ZXBM5409Q	DIODE INC.	DIGIKEY	ZXBM5409Q-N-UDI-ND



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