CIRCOR AEROSPACE
Technology Takes Flight

MotorTechnology

Application Assistance: Electromagnetic Brakes

Please consider the following key factors when selecting a Motor Technology brake for an application:

1) Will the brake be used as a *stopping* or *holding* brake?
    a. Does the brake need to stop the motor from rotating or keep a stationary load from moving?
    b. *Stopping Brake:*
        i. What is the inertia of the load that the motor is moving?
        ii. At what speed will the motor be operating when the brake is engaged? Important: As inertia increases, so will the motor speed. It will take more time for the motor to come to rest and brake life will be shorter due to the wear of the brake's friction pad material.
    c. *Holding Brake:*
        i. Is a brake really necessary? All permanent magnet motors have an inherent cogging/detent torque that exists from the attraction between the magnets and the steel of the armature. This torque alone may be enough to prevent an external load from rotating the motor shaft when the motor is off.
        ii. Motor Technology gearboxes actually "step up" the potential holding torque due to motor cogging. The holding torque out at the gearbox shaft will be equal to the cogging torque at the motor shaft multiplied by the gearbox speed reduction and divided by the gearbox efficiency. Please feel free to contact our application engineers if you have any questions related to the concept of motor cogging torque.
        iii. What is the required holding torque of the brake?

2) Will the brake be used on a gearmotor? If so, the gearbox will act to "amplify" the brake torque acting on the motor. The brake torque at the gearbox shaft will be equal to the brake torque at the motor shaft multiplied by the gearbox speed reduction and divided by the gearbox efficiency.

3) Select if the motor will use either a *parallel* or *series brake*. The major advantages and key concerns for each type are outlined in the General Specifications on page 3.

a. Please see Figures 1 and 2: "Wiring Schematics: Parallel Brake on page 4 for different configurations.

   i. Two (2) power sources are needed (one for the motor and one for the brake).

   ii. There may be a slight delay (of several hundred milliseconds) between the time that power is removed from the motor and the time that the brake engages. This potential delay is caused by motor back EMF generating a current through the brake coil.

   iii. Will the configuration be used on a system with an aiding load condition (i.e., Lowering a heavy door, or any other gravity assisted application)? In this example, the aiding load could continue driving the motor after power is removed from the motor. This may cause the motor to generate a current keeping the brake coil active and preventing the brake from engaging. Best recommendation for this scenario is Figure 1 on "Wiring Schematics," page 4.

b. Please see Figure 3: "Wiring Schematics: Series Brake on page 4 for configuration.

   i. Will the motor operate at conditions of little or no load? If so, a series brake may not stay disengaged properly during motor operation. A series brake coil "sees" the same current as the motor, and a low load current can mean that the brake coil does not have enough power to keep the brake disengaged. Best recommendation for this scenario is a parallel brake.

General Specifications: Electromagnetic Brakes

PARALLEL BRAKES

Description: Parallel brakes have their own sets of leads and can be operated independently of the motor.

Advantages: Independent operation; performance can be controlled quite accurately. Ability to remain disengaged even when the motor is operating at low torque conditions.

Key Considerations: Parallel brakes generally have lower levels of holding/stopping torque than series brakes. Depending upon the hook-up, back EMF from the motor can delay brake engagement time after the motor power has been removed.

General information: Parallel brakes are spring-set and fail-safe – indicating they will mechanically engage if power is removed. Brake leads are Teflon-insulated per MIL-W-1878, Type "E" with gauge dependent upon voltage and current requirements. Parallel brakes are mounted to the rear of the motor and enclosed/protected by an aluminum cover, chemically filmed per MIL-C-5541.

SERIES BRAKES

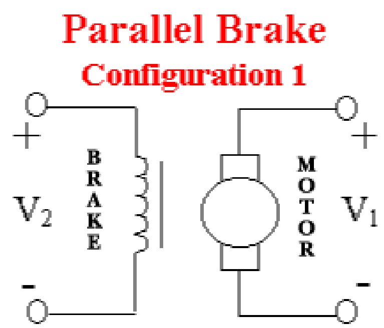
Description: Series brakes leads are wired internally in series with the motor.

Advantages: Series brakes have potential for more stopping/holding torque than parallel brakes. They generally have quicker engagement/response times than parallel brakes once the power is removed from the motor.

Key Considerations: Series brakes cannot be operated independently from the motor. They can have difficulty remaining disengaged when the motor is operating at low torque conditions. Not recommended for low voltage applications.

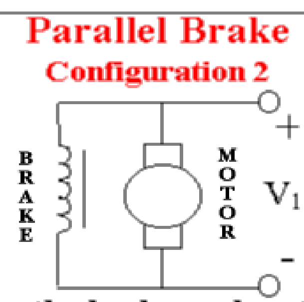
General Information: Series brakes are spring-set and fail-safe –indicating they will mechanically engage if power is removed. Series brakes are mounted to the rear of the motor and are enclosed/protected by an aluminum cover, chemically filmed per MIL-C-5541.

Wiring Schematic: Electromagnetic Brakes



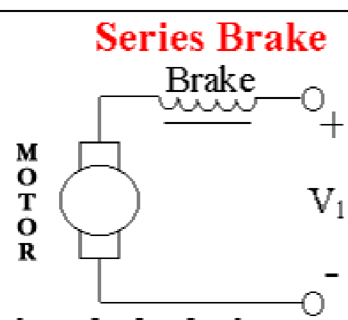
In this configuration, the brake and motor are connected to different power sources. This allows the brake to be precisely controlled and operated independently of the motor.

Figure 1



In this configuration, the brake and motor are connected to the same power source. Caution: When power is removed in this configuration, the potential exists for back EMF from the motor to cause a delay (of several hundred milliseconds) in brake engagement time.

Figure 2



In this configuration, the brake is connected internally in series with the motor. In this configuration, only the motor leads need to be connected to a power source. (The brake will "see" the same current as the motor.)

Figure 3

DIMENSIONS AND DATA: Electromagnetic Brakes

Motor Model	Brake Diameter (in.)	Maximum Length of Brake (in.)	Maximum Inertia of Brake (oz-in-sec2)	Maximum Weight of Brake (oz)	Maximum Torque Capability of Brake (oz-in)
RCMR, RCML, CMR, CML, CIR, CIL	1.25	1.25	2.44E-05	TBD	See note below *
DMR, DML	1.5	1.5	6.71E-05	TBD	See note below *
EMR, EML	1.75	1.75	4.42E-04	TBD	See note below *
FMR, FML, FIR, FIL	2.25	1.75	7.55E-04	TBD	See note below *
HIR, HIL	2.75	2	2.77E-03	TBD	See note below *
JMR	TBD	TBD	TBD	TBD	See note below *

* Note: Torque values for brakes are not listed due to the amount of torque that can vary and is dependent upon how the brake is used in the application. Please contact our application engineers to assist in selecting the appropriate brake for the application.