

The DynaMotor™ Electronic Brushless Repulsion Motor

A Novel High Torque Brushless
Repulsion Motor

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(EBR)
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- Universal motor torque-speed characteristic

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- Inverter or dc type drives are good technology but not cost effective for domestic and residential application
- Conventional ASDs have a power controller between the ac line and the motor
- Conventional ASDs using dc motors have a brush/commutator maintenance issue

The Electronic Brushless Repulsion Motor

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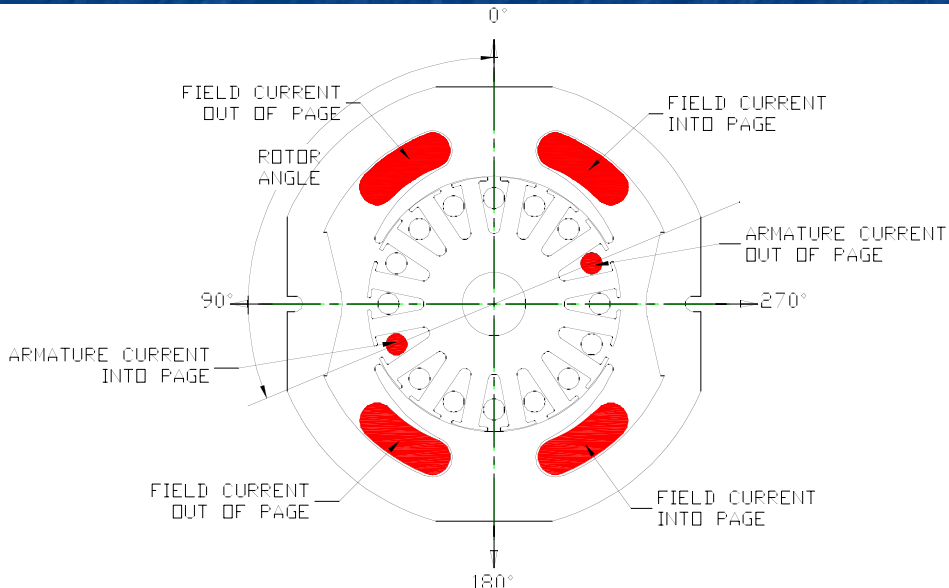
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- Simple construction – similar to a universal motor – see US Patent 5,424,625 Drawing Fig. 1

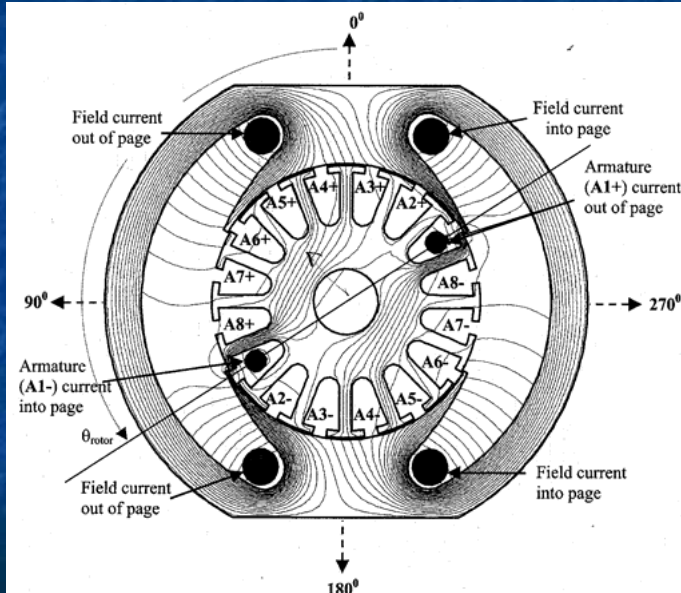
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- 2-Pole and 4-Pole construction most common types with 6-Pole and 8-Pole as viable alternatives

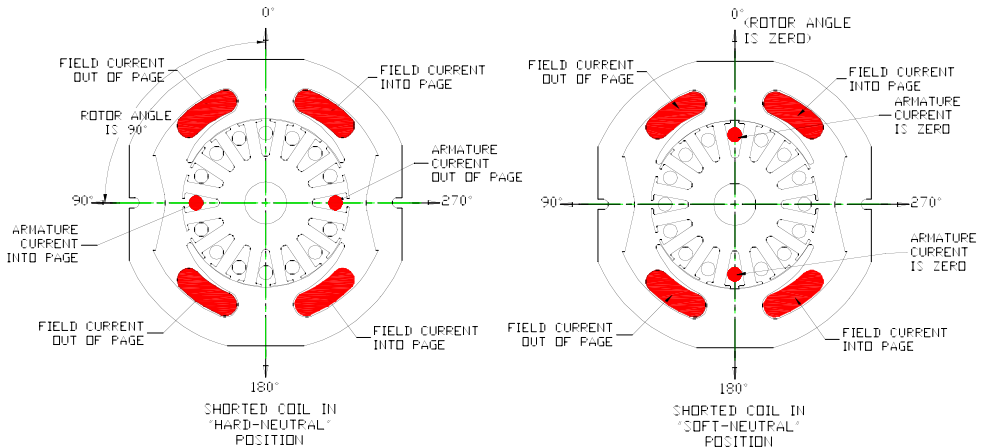
2-Pole EBR Definitions



Field Pattern of 2-pole EBR Motor



"Hard" and "Soft" Neutral Positions



Direction of Torque Produced by a Shorted Armature Coil

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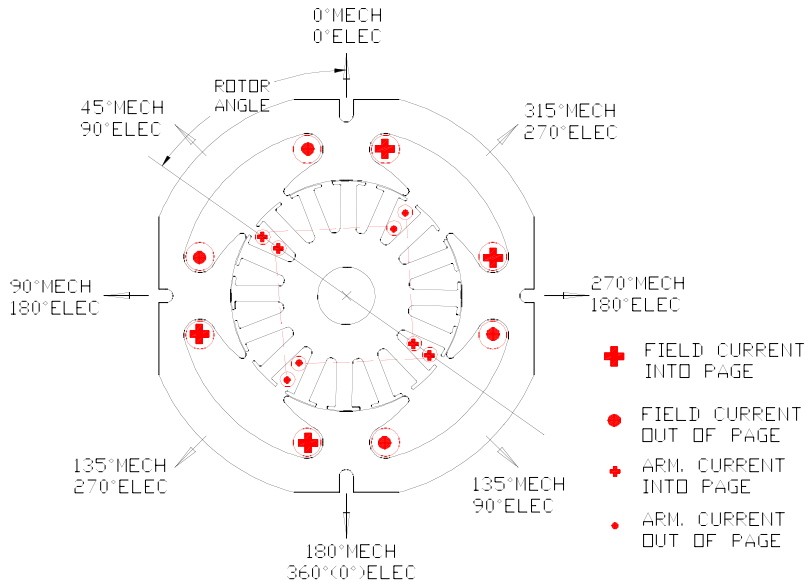
Direction of Torque Produced by a Shorted Armature Coil

- Rotor angles between 0° and 90° make negative torque
- Rotor angles between 90° and 180° make positive torque
- Rotor angles between 180° and 270° make negative torque

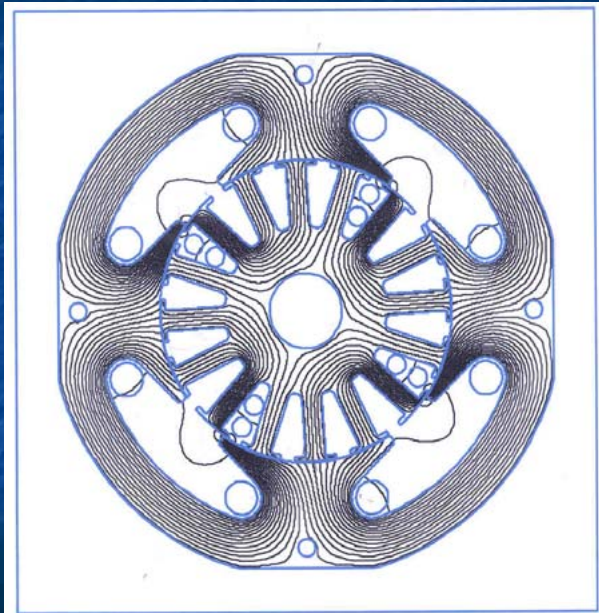
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- Rotor angles between 0° and 90° make negative torque
- Rotor angles between 90° and 180° make positive torque
- Rotor angles between 180° and 270° make negative torque
- Rotor angles between 270° and 360° (0°) make positive torque

4-Pole EBR Definitions



Field Pattern of 4-Pole EBR Motor



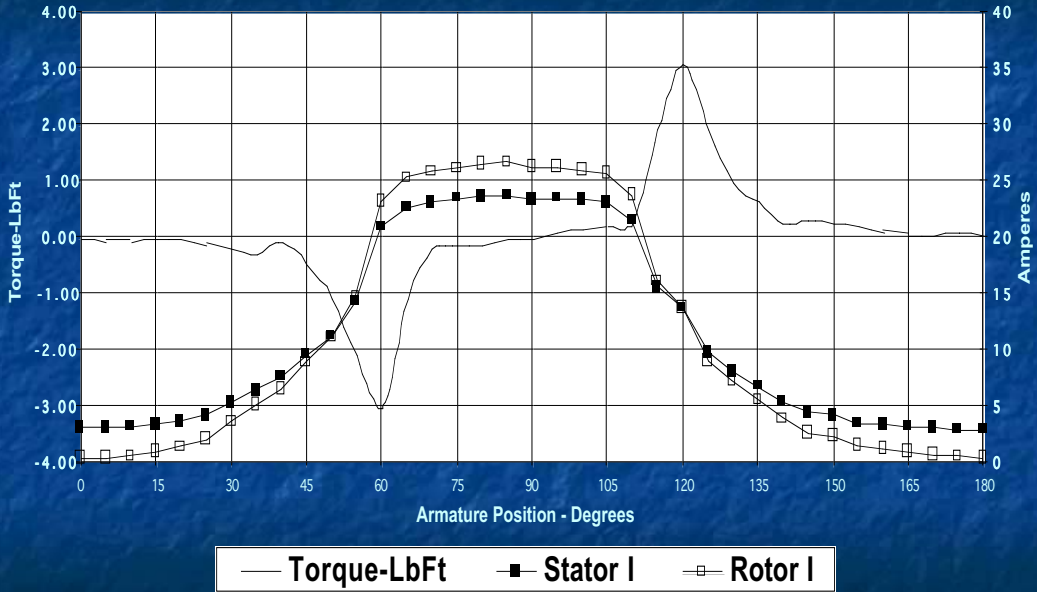
Torque Production as a Function of Rotor Position

- The torque produced by a shorted armature coil varies as the rotor angle changes

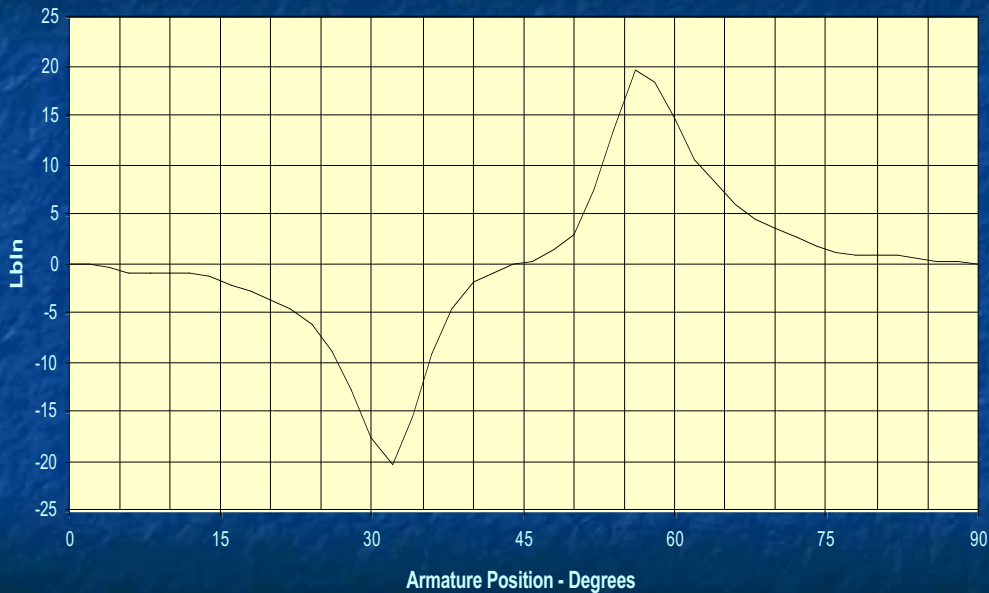
Torque Production as a Function of Rotor Position

- The torque produced by a shorted armature coil varies as the rotor angle changes
- The shape and polarity of the torque has half-wave symmetry about the 90° (270°) electrical position.

Two-Pole Motor, Vstator = 43Vac, one armature coil shorted



48 Frame 4-pole motor, $V_{\text{stator}} = 50\text{Vac}$, one armature coil shorted



Torque Production as a Function of Rotor Position

- To produce positive torque it is only necessary to short the armature coil when it is in the positive torque region

Torque Production as a Function of Rotor Position

- To produce positive torque it is only necessary to short the armature coil when it is in the positive torque region
- To produce negative torque it is only necessary to short the armature coil when it is in the negative torque region

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- Position Control activates the solid-state shorting switch with a photoelectric device over a fixed included rotor angle called the "Control Angle"
- Basic circuit elements include a small power supply, some photo detectors, the solid-state switches to short the coils, and a transient energy clamp circuit

Controlling the EBR Motor

- The placement of the photo detectors have the same angular spacing as the angular spacing of the armature coils

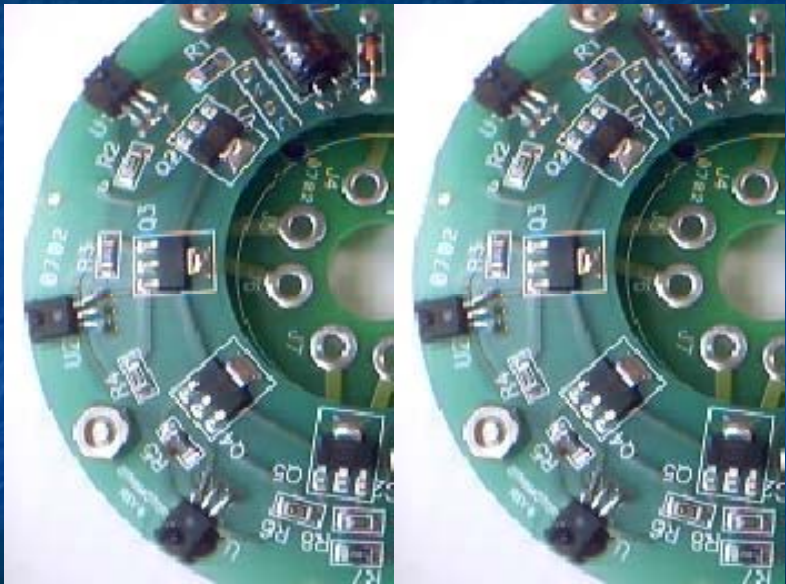
Controlling the EBR Motor

- The placement of the photo detectors have the same angular spacing as the angular spacing of the armature coils
- Controlling the photo detectors is accomplished in simple position control by placing LEDs on the stator. Leds are placed to activate the photo detectors each time they enter a torque producing region.

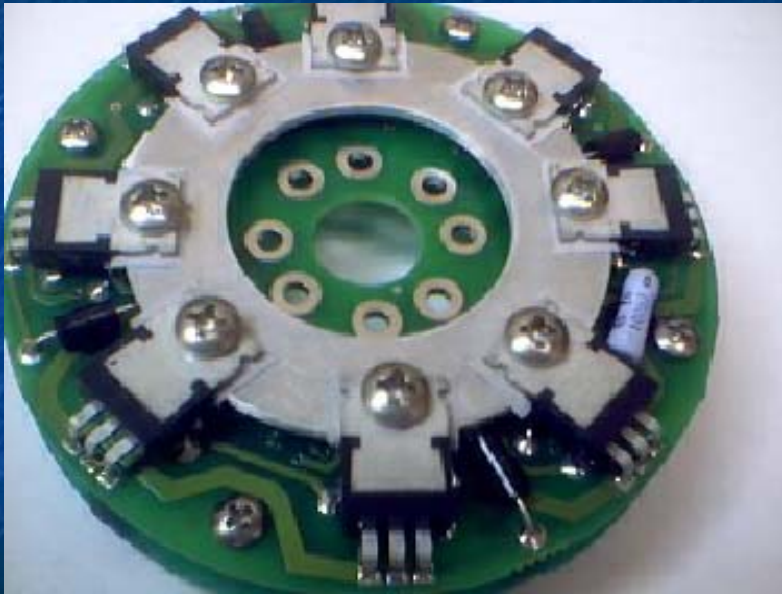
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- Multiple coils produce many torque pulses per revolution

Photo detectors on the control assembly



MOSFET power switches on control assembly



LED array



Controlling the EBR Motor

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- The alternative to a simple position type control is to use a variable position control
- This method uses the same LED arrangement as a simple position control except the number of LEDs that are turned on in the LED array is controlled to adjust the control angle, thereby controlling the motor torque and speed.

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- Timer Control of the EBR motor

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- Timer Control of the EBR motor
- Simplified positioning of the photo detectors and LEDs
- Accurate speed control as a by product of timer control
- Timer control is most readily implemented using a small microprocssor

Performance of the EBR motor

- Speed range of 5 to 1 in constant HP application

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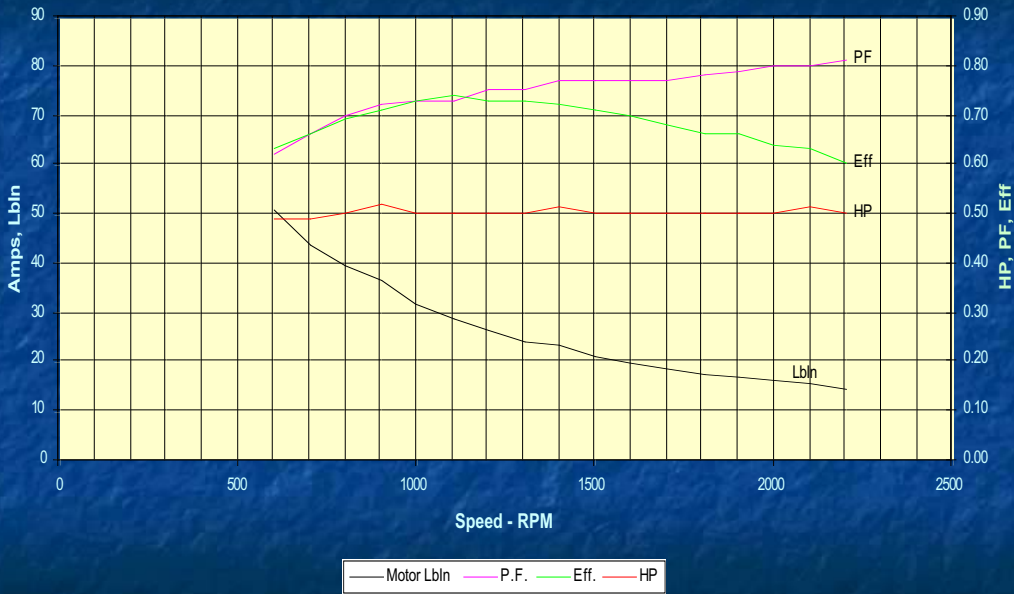
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- Speed range of 5 to 1 in constant HP application
- Capable of operating above “base speed”
- Capable of running on sine or square-wave voltage supplies
- Multiple motors can operate from the same power source
- Operates well in constant HP or constant torque applications

56 Fr motor w/6 inch stack - Constant HP



56 Frame 6" Stack 4-Pole Motor - Constant T Load



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- High speed applications can be satisfied with a self contained brushless drive
- An EBR motor is a better choice than forcing a conventional motor to be a variable speed motor