Company confidential Presentation

Epoch Fans
When Silence is Golden and Less is More

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# Falco eMotors Pvt Ltd
## *Learning Center of HVLS fans*
## *Comparison of PMSM vs IM*

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# Comparison of PMSM vs IM

| Sr. No. | Permanent Magnet Synchronous Motor (PMSM) | Induction Motor (IM) |
|---|---|---|
| 1 | Speed Torque characteristic is flat in nature. | Speed Torque characteristic is non-linear in nature. |
| 2 | Shaft speed is synchronized with the applied frequency of supply current. No slip. $N_s = \frac{120 \times f}{P}$ | Shaft speed is always less than Synchronous speed because of slip. Slip increases with load. $N = \frac{120 \times f}{P} - Slip$ |
| 3 | Can operate at full torque even at lower speeds | Cannot operate at full torque at lower speed |
| 4 | Because it has permanent magnets on the rotor, the smaller size can be achieved for a given output power | Because both stator and motor have winding , output power to size is lower than PMSM |
| 5 | The rotor inertia is low. This enables better dynamic characteristics. | The rotor inertia is high. This enables poorer dynamic characteristics. |
| 6 | The starting current is rated. No special starter circuit is required. | The starting current is approximately up to 7 times for the rated voltage. Stator circuit rating should be carefully selected. It normally uses a star delta starter. |
| 7 | Wider speed & torque range | Lesser speed range than PMSM motors |
| 8 | More efficient than Induction Motors, so run more effectively under the same load conditions. | Even NEMA premium efficiency units exhibit degraded efficiencies at low load. |
| 9 | Lower operating temperatures reduces wear & tear, maintenance; extends bearing & insulation life. | Both stator & rotor are windings, they both contribute to heat. Waste heat is capable of degrading insulation essential to motor operation. |
| 10 | Exhibits higher initial cost but lower operating cost. | Has lower initial cost but higher operating cost. |

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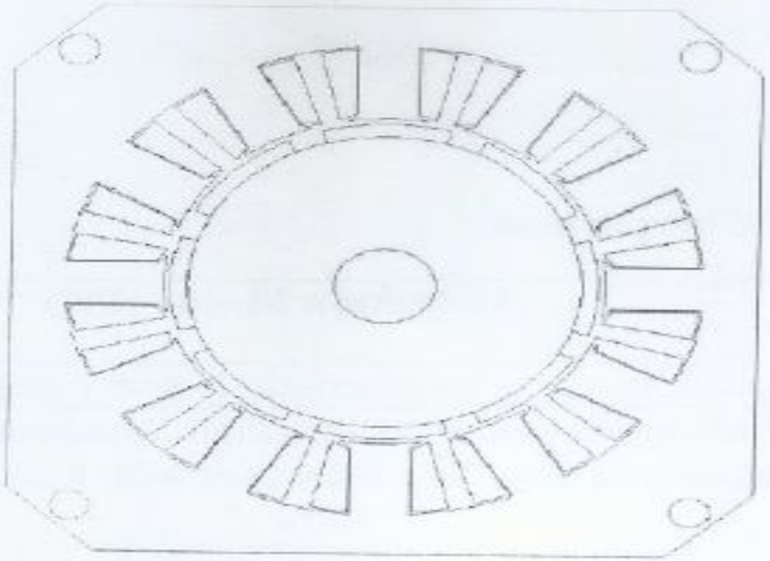
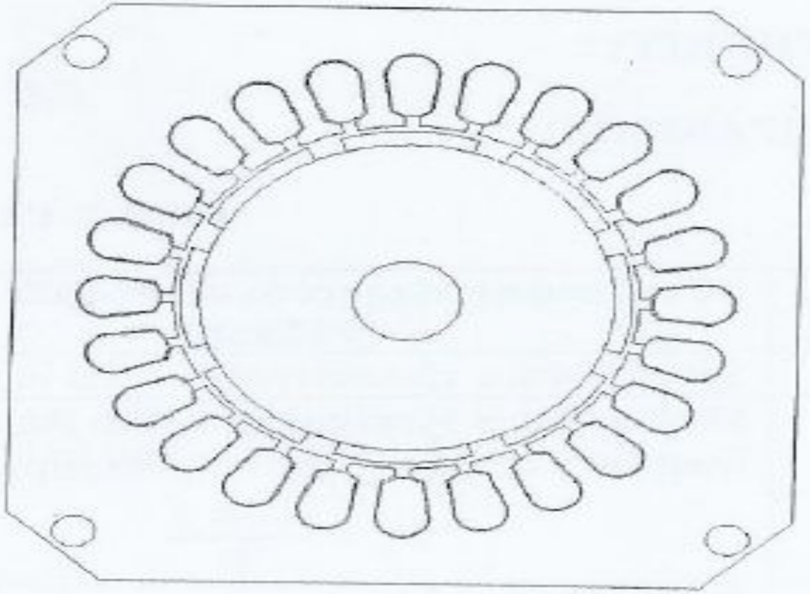
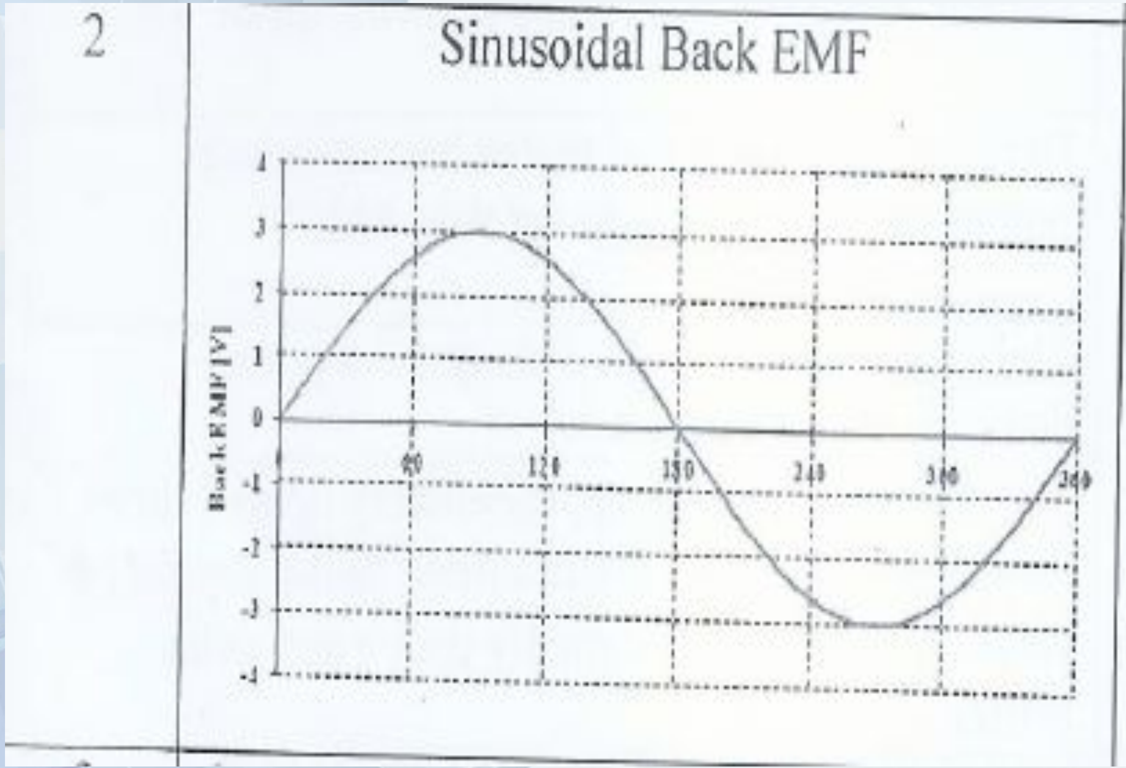
# Comparison of PMSM vs BLDC Winding Construction

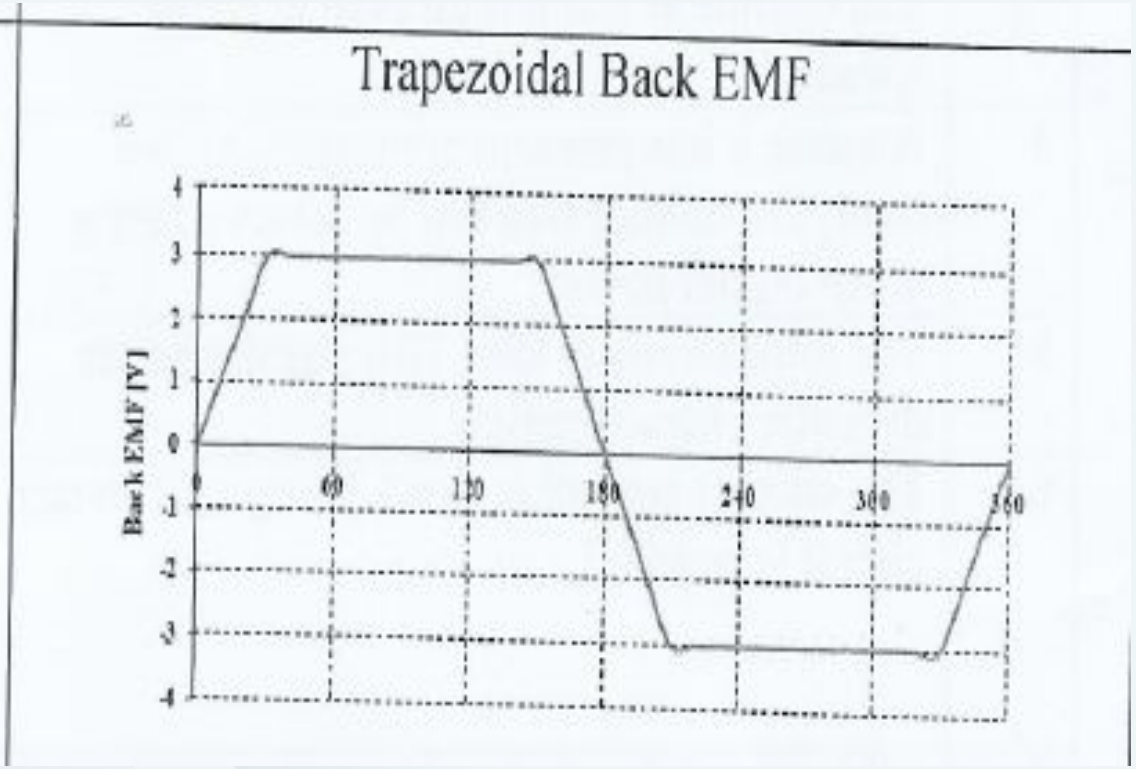
| Sr. No. | PMSM | BLDC |
| --- | --- | --- |
| 1 | Distributed Windings  | Concentrated Winding  |

# Comparison of PMSM vs BLDC
# Back EMF

**PMSM**




**BLDC**



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# Comparison of PMSM vs BLDC
# Back EMF

| | PMSM | BLDC |
|---|---|---|
| 3 | In order to achieve constant torque we inject sinusoidal current | In order to achieve constant torque we inject square wave current |
| 4 | Needs complex control algorithm (FOC & SVPWM) | Easier to control (6 step) and only dc currents required |
| 5 | No torque ripple at commutation | Torque ripple at commutation |
| 6 | Higher cost but high performance | Lower cost but poor performance (more power consumption, higher harmonics & higher temperature than PMSM) |
| 7 | Sensorless control | Needs hall sensors |
| 8 | Higher efficiency than BLDC & Induction Motors | Lower efficiency as compared to PMSM |
| 9 | Higher Power to weight ratio than IM | Higher Power to weight ratio than IM |
| 10 | Dynamic response of sensorless FOC+SVPWM is suitable for any load | Dynamic response of six-step control (trapezoidal control) is not suitable for dynamically changing loads |

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# Comparison of PMSM vs BLDC
# Efficiency of PMSM vs IM


General range of efficiencies for Permanent Magnet Motors
General range of efficiencies for AC Induction Motors - NEMA Premium & Super Premium
General range of efficiencies for AC Induction Motors EPAct

Fig. 1 Statistics: Efficiency of PMSM versus Induction Motors

# Comparison of PMSM vs BLDC Back EMF


Fig. 2 Graph: Efficiency of PMSM versus Induction Motors