

The
Fundamentals of
Brushless
Permanent
Magnet Motor
Design - **Part 2**

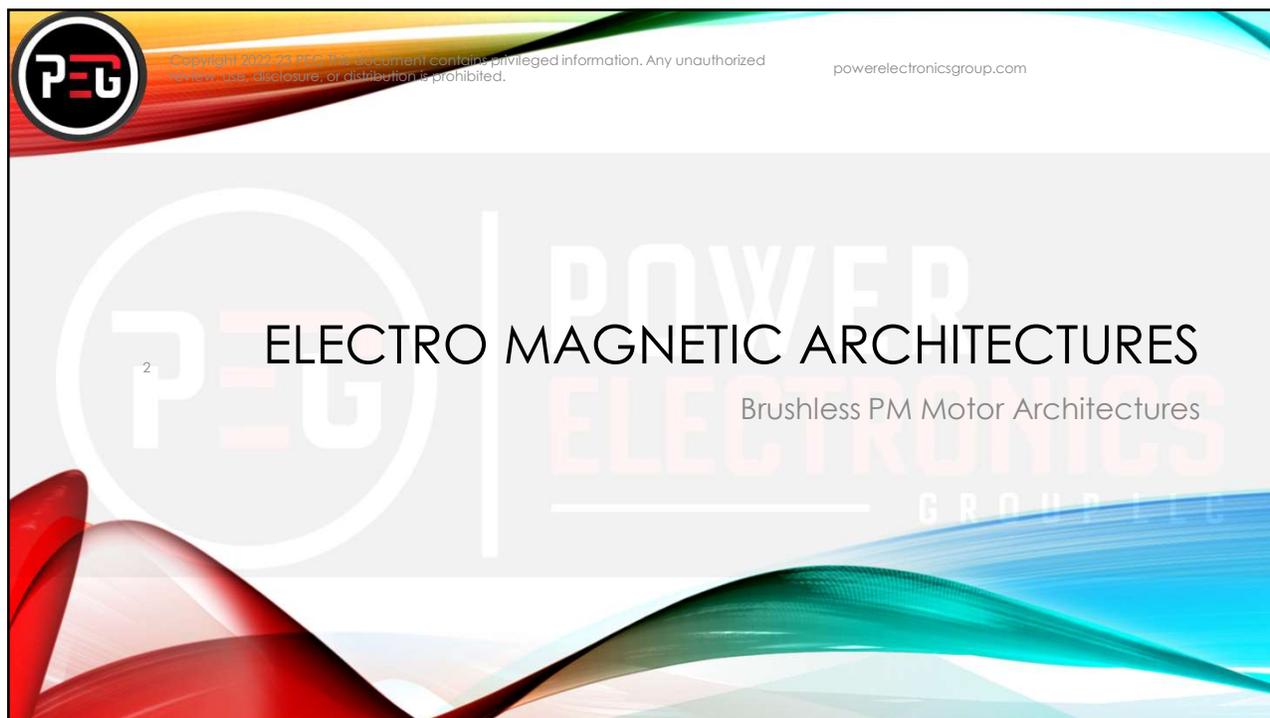
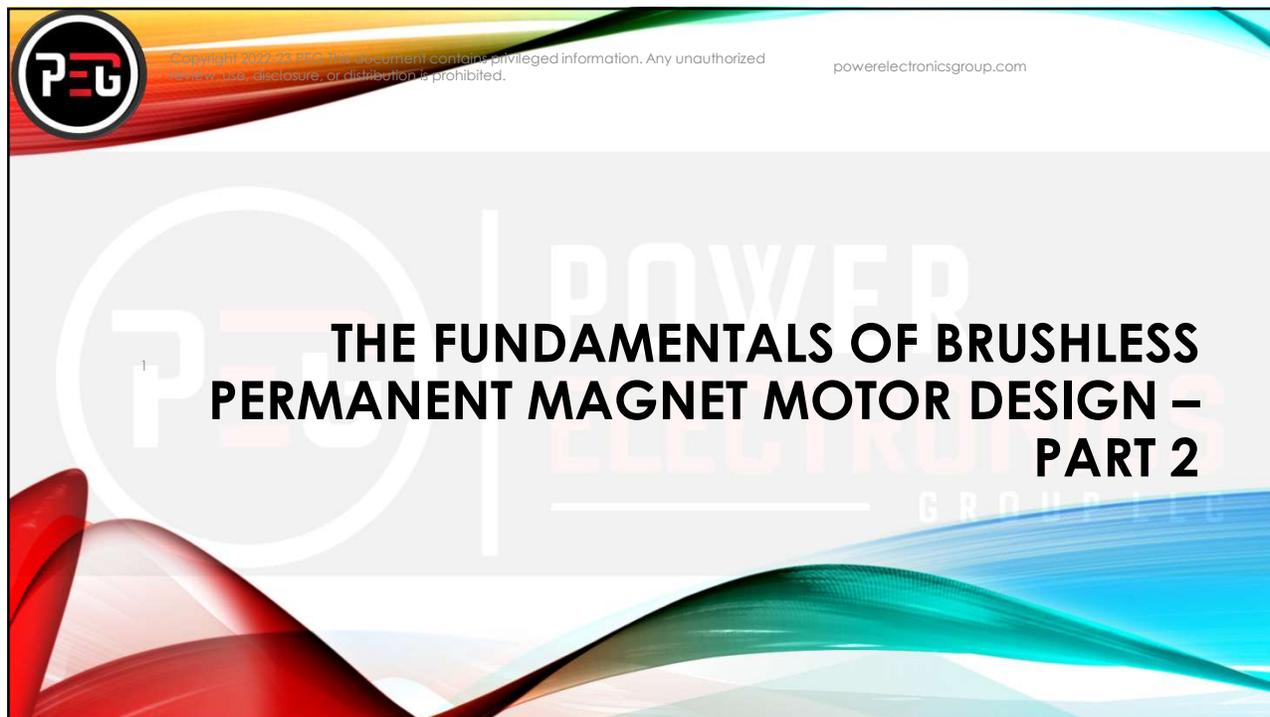
**Electro-Magnetic
Architectures**

By

Rakesh Dhawan

BTech, MSEE, MBA







ARCHITECTURES

- Rotor Architectures (Interior)
- Rotor Architectures (Exterior)
- Stator Architectures (Interior)
- Stator Architectures (Exterior)

POWER ELECTRONICS GROUP LLC

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- **Surface Mount Magnets**
 - Radial magnets;
 - Two radial magnets per pole;
 - Three radial magnets per pole;
 - Four radial magnets per pole;
 - Parallel magnets.

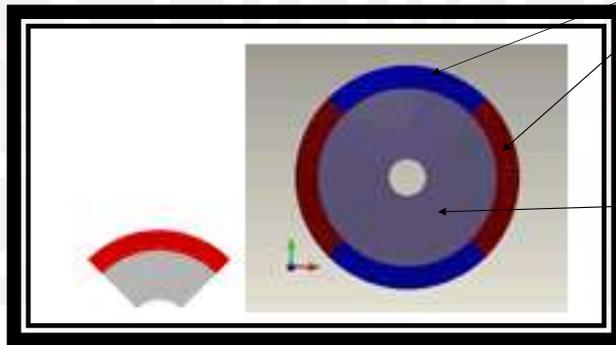
POWER ELECTRONICS GROUP LLC

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- Surface mounted with radial magnets



Images Courtesy of Infolytica

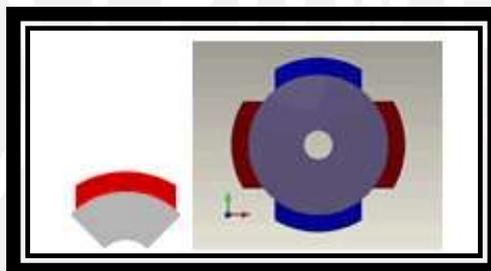
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- Surface mounted with parallel magnets



Images Courtesy of Infolytica

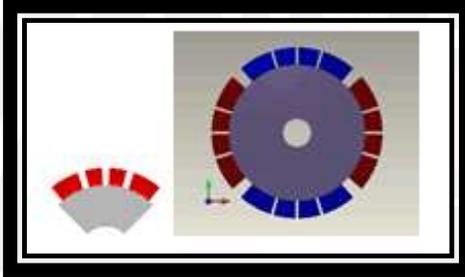
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- Surface mounted with four radial magnets per pole



Images Courtesy of Infolytica

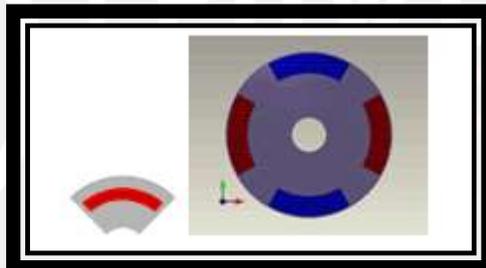
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- Inset radial magnets



Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- **Spoke Magnets**
 - Embedded Magnets;
 - Non-Embedded Magnets.

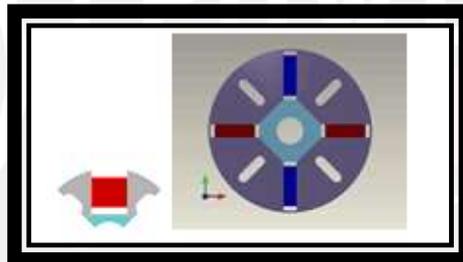
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- **Spoke with embedded magnets**



Images Courtesy of Infolytica

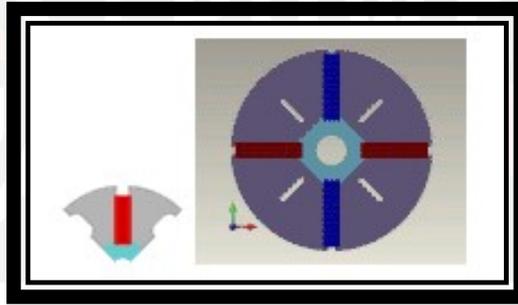
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- Spoke with non embedded magnets



Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- **Bread-loaf Magnets**
 - Non-Embedded Magnets (NEMs);
 - Two NEMs per pole;
 - Four NEMs per pole;
 - Six NEMs per pole;
 - Eight NEMs per pole;
 - Ten NEMs per pole;
 - Twelve NEMs per pole;
 - Sixteen NEMs per pole.

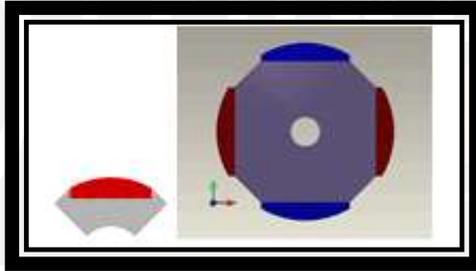
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- Bread-loaf with non-embedded magnets



Images Courtesy of Infolytica

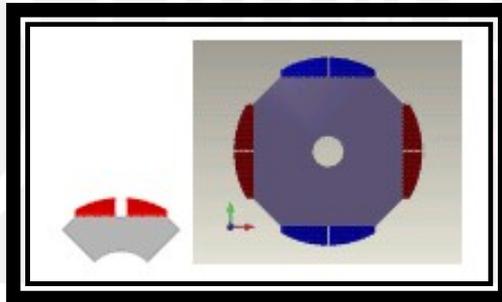
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- Bread-loaf with two non-embedded magnets per pole



Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

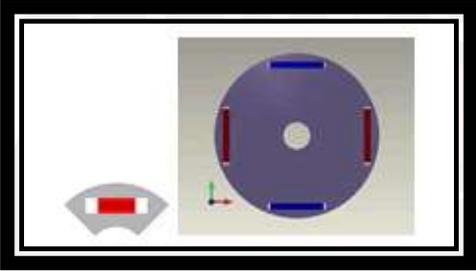
- **IPM**
 - Lateral Magnets;
 - Curved Magnets;
 - Inset Lateral Magnets;
 - Angled Barrier;
 - Angled Barrier (2 Layers);
 - Angled Barrier (3 Layers);
 - Angled Barrier (4 Layers);
 - V-Shaped Barrier (2 Layers);
 - Variable Orientation Magnets;
 - Embedded Variable Orientation Magnets.

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- **IPM with lateral magnets**



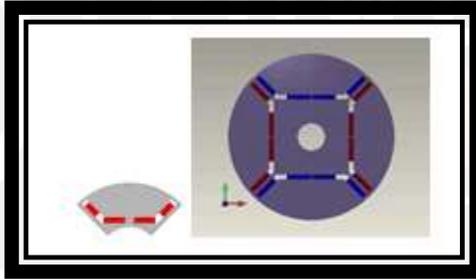
Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- IPM with angled barrier



Images Courtesy of Infolytica

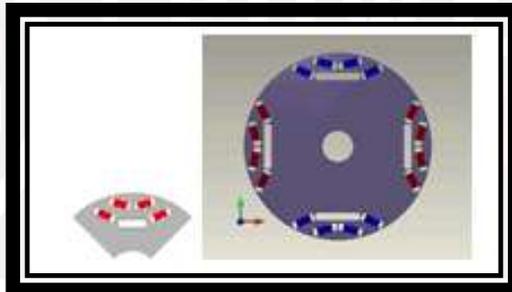
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- IPM with V-shaped barrier (2 layers)



Images Courtesy of Infolytica

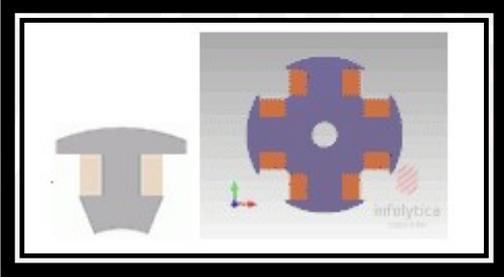
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (INTERIOR)

- **Wound square type**



Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



ROTOR ARCHITECTURES (EXTERIOR)

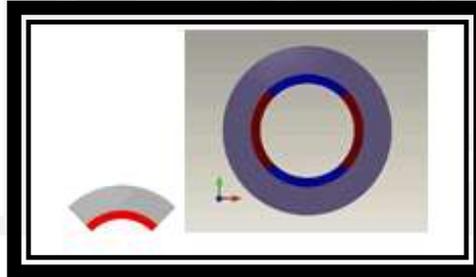
- **Surface Mount**
 - Radial Magnets;
 - Two Radial Magnets per pole;
 - Three Radial Magnets per pole;
 - Four Radial Magnets per pole;
 - Parallel Magnets.
- **Wound square**

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



ROTOR ARCHITECTURES (EXTERIOR)

- **Surface mounted with radial magnets**



Images Courtesy of Infolytica

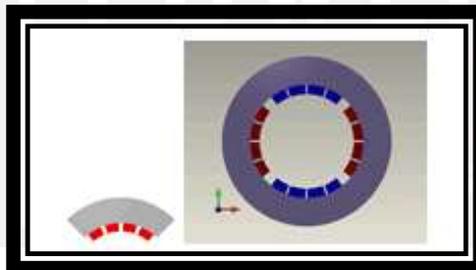
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (EXTERIOR)

- **Surface mounted with 4 radial magnets per pole**



Images Courtesy of Infolytica

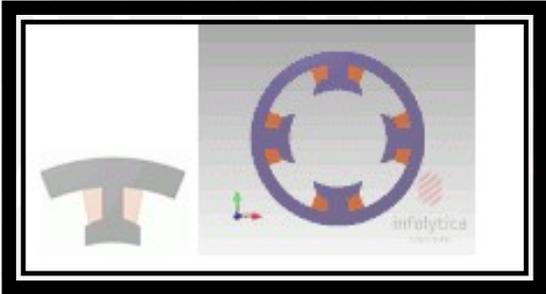
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



ROTOR ARCHITECTURES (EXTERIOR)

➤ **Wound square**



Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

- Square;
- Square with curved tangs;
- Round;
- Parallel tooth;
- General square;
- General round.

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

- Parallel square;
- Parallel round;
- Parallel;
- Slotless.



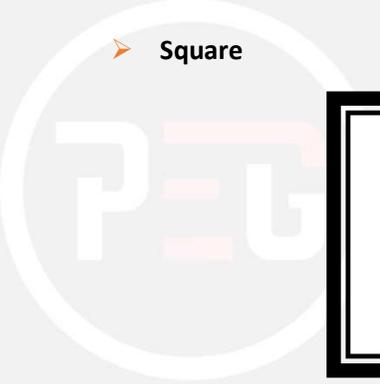
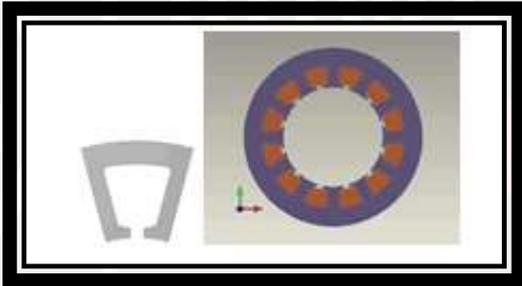
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

➤ Square



Images Courtesy of Infolytica

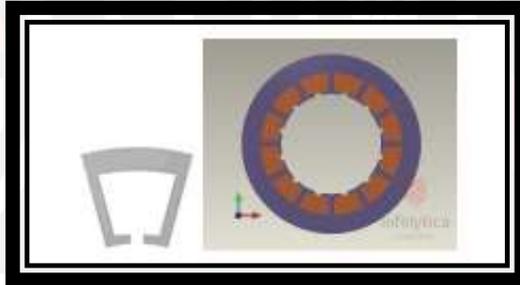
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

- Square with curved tangs



Images Courtesy of Infolytica

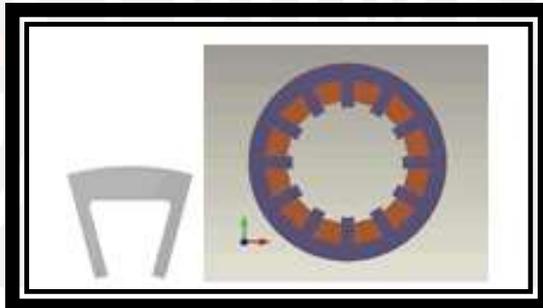
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

- Parallel tooth



Images Courtesy of Infolytica

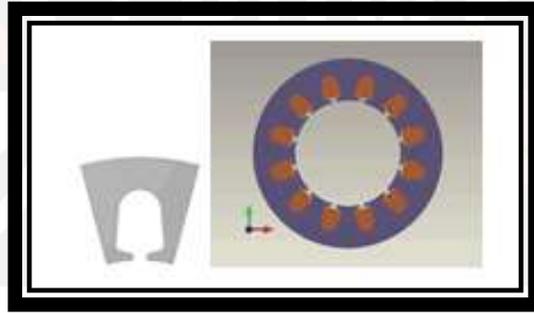
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

- General round



Images Courtesy of Infolytica

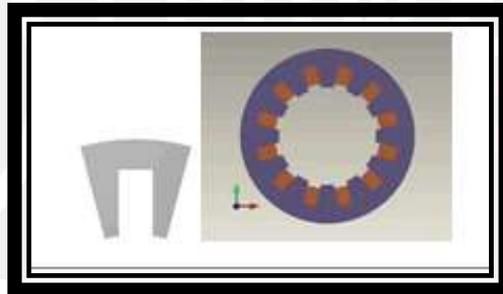
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

- Parallel



Images Courtesy of Infolytica

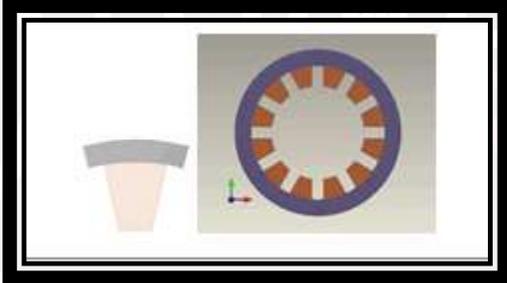
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (EXTERIOR)

- Slotless



Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



STATOR ARCHITECTURES (INTERIOR)

- Square;
- Square with cylindrical tange;
- Round;
- Parallel tooth;
- General square.

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited. powerelectronicsgroup.com



STATOR ARCHITECTURES (INTERIOR)

- General round;
- Parallel round;
- Parallel;
- Slotless.

POWER
ELECTRONICS
GROUP LLC

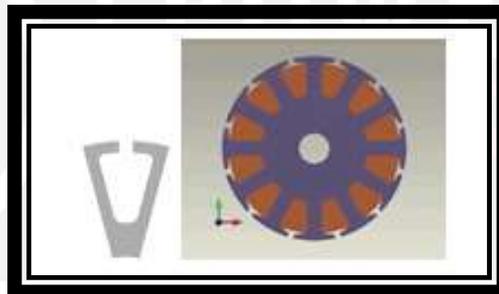
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (INTERIOR)

- Square



Images Courtesy of Infolytica

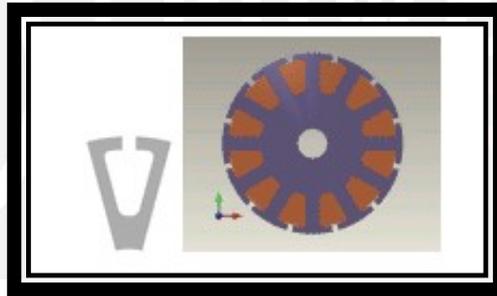
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (INTERIOR)

- Square with cylindrical tangs



Images Courtesy of Infolytica

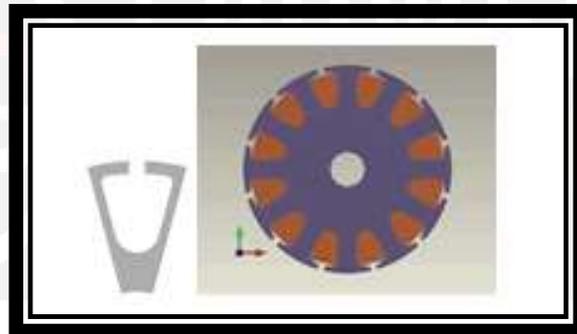
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (INTERIOR)

- Round



Images Courtesy of Infolytica

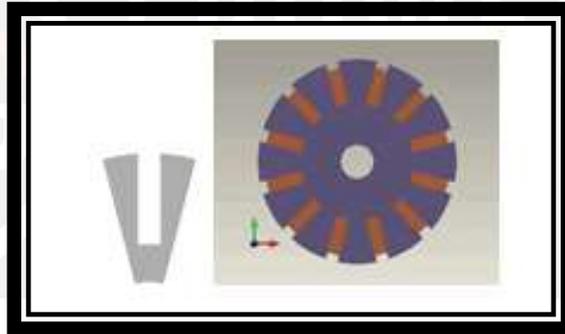
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (INTERIOR)

- Parallel



Images Courtesy of Infolytica

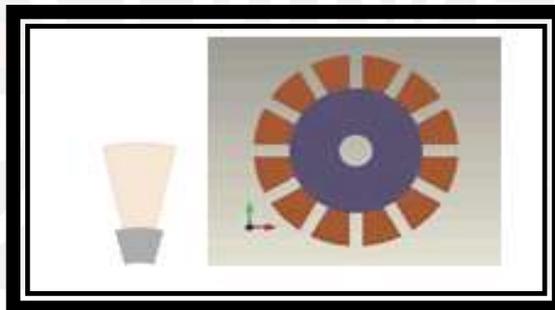
Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com



STATOR ARCHITECTURES (INTERIOR)

- Slotless



Images Courtesy of Infolytica

Copyright 2022-23 PEG This document contains privileged information. Any unauthorized review, use, disclosure, or distribution is prohibited.

powerelectronicsgroup.com