

Permanent Magnet Generators for On Board Vehicle Power

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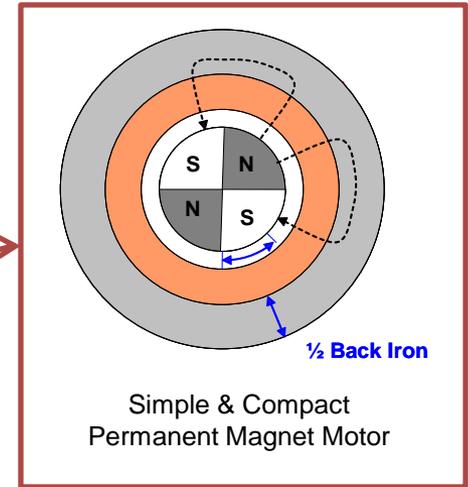
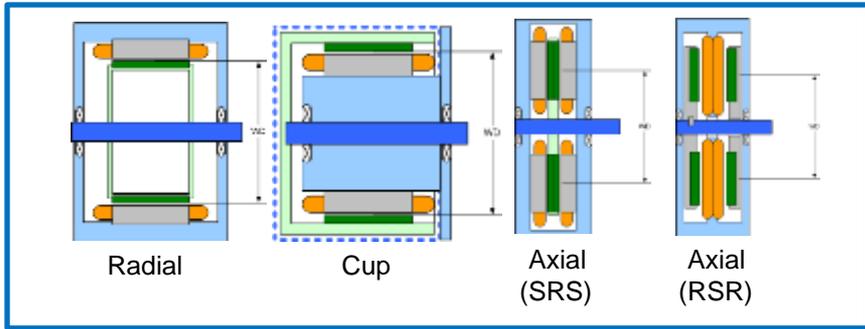
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Distribution Statement A

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Benefits of Permanent Magnet (PM) Machines

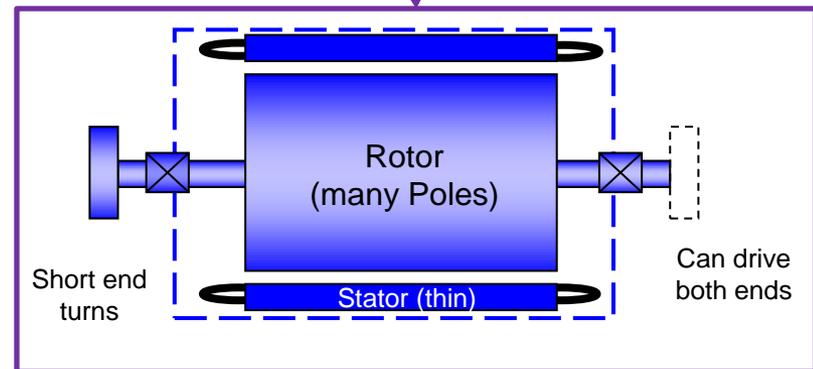
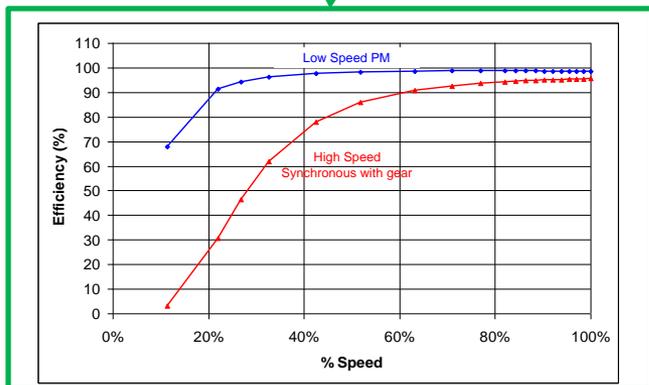


Flexible topologies

Robust

High power density

Efficiency across speed range



Relevant DRS PTI OBVP PM Experience



PA44



- 450hp @ 2860 RPM (825 ft-lb)
- 1475 ft-lb at stall
- 25.5" D x 8.8" L
- 395 lbs



PR40



- 33kW @ 1800 RPM (130 ft-lb)
- 21.2" D x 4.7" L
- 113 lbs



PA57



- 1000hp @ 3600 RPM (1450 ft-lb)
- 2000 ft-lb at stall
- 31" D x 10.5" L
- 780 lbs



PC36



- 240hp @ 4600 RPM (275 ft-lb)
- 500 ft-lb at stall
- 18" D x 7.2" L
- 139 lbs



PC45



- 115+kW @ 1700 RPM (480 ft-lb)
- 60kW constant
- 19.3" D x 10.1" L
- 241 lbs



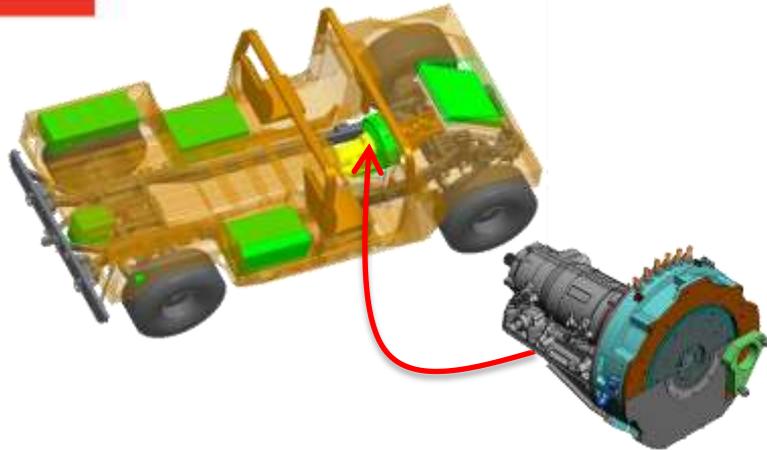
Motor Model Series Designators:

PA = Permanent Magnet Axial Field

PR = Permanent Magnet Radial Field

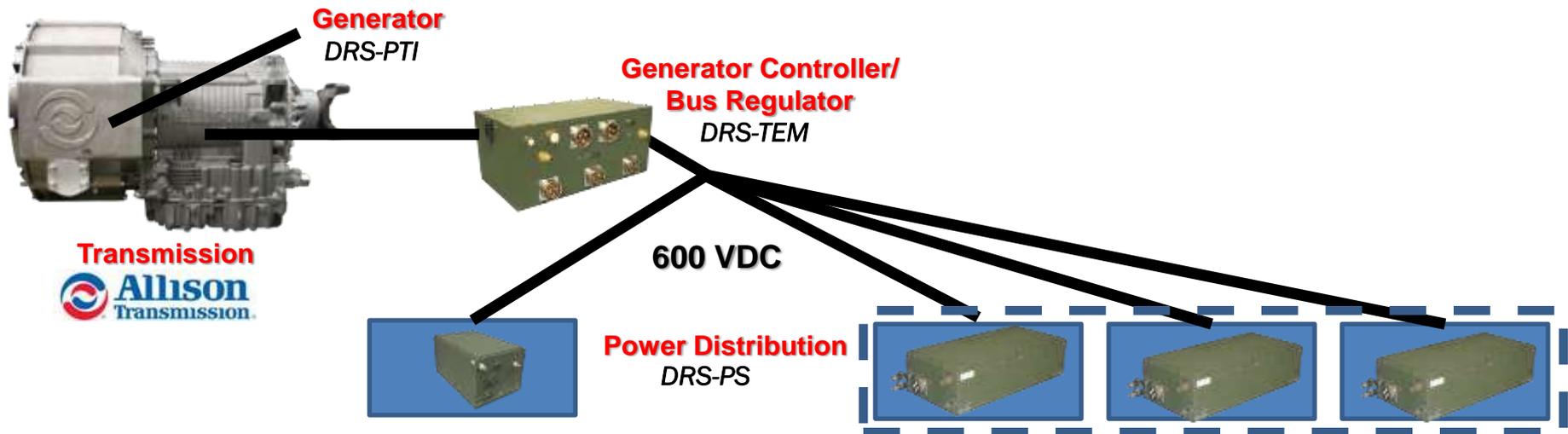
PC = Permanent Magnet Cup Motor

DRS Approach to OBVP – Driveline Integration



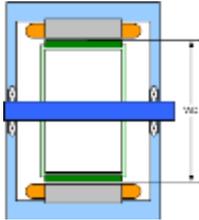
Advantages:

- No effect on driveline overall length
- One unit... similar to replacing a transmission
- Rear crankshaft power draw
- Suitable for starter functionality
- High torque, low speed



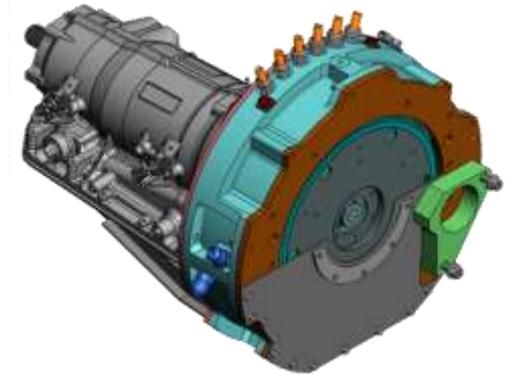
System-level view, solid teaming, and tight integration (mechanical and electrical) critical to solution development

PR40 Permanent Magnet Generator



Radial PMG:

- Works within available space outboard of the torque converter (GTP 4L80 transmission)
- Rotor assembly replaces the flywheel
- Starting ring gear incorporated into motor rotor
- 33kW @ 1800 RPM (130 ft-lb)
- 10kW on-the-move
- 21.2" D x 4.7" L, 113 lbs
- 400 VDC system output (controller setting)
- 95C coolant

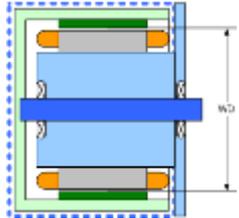


PR40 Status

- 1 Development Vehicle, 1 Bid Sample Vehicle, 1 Pre-production Deliverable, 15 units on order by USMC and in production. 1 full system SIL (test cell test bed) used for continued development and refinement of hardware, software, and expanded kit
- 2 vehicles passed mobile electric power test sequence at proving ground. 1 vehicle passed basic proving ground driving sequence (5,000 miles). Pre-production at or going to APG for completion of OBVP power and vehicle checks.
- DRS establishing capability for continued low rate builds. Continuing work on kit cost reduction and capability envelope expansion.



PC45 Permanent Magnet Generator



Cup PMG:

- Most suitable for space made available by removal of the mechanical PTO (ATI 3200 MSG transmission)
- Evolution of PR40 integration... true TIG (Transmission Integral Generator)
- 60kW constant
- 19.3" D x 10.1" L, 241 lbs
- 600 VDC system output (controller setting)
- 80C coolant



PC45 Status

- One unit in System Integration Lab (full system test cell)
- One unit in test mule durability runs (driveline plus containerized power kit and loads)
- One unit for TARDEC SIL
- On-going LUT/LRIP preparations



Conclusions



- Permanent magnet generators offer many advantages for OBVP
- DRS Technologies has breadth and depth of relevant PMG experience
- Several benefits with transmission integral solutions



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