

# Permanent Magnet Synchronous Machine Models Comparison

Refer to the [PMSM BLDC Section](#) and [PMSM SH Section](#) pages for information related to configuring these models in the Add-On.

|  | Variable D-Q (VDQ)   |  | Spatial Harmonics (SH)  |  |
|--|--|--|---|--|
|  | Constant Ld/Lq   | Variable Ld/Lq   | V1  | V2   |
| <b>Description</b>                           | 2 phase equivalent circuit model with a d-q rotating reference frame and variable inductance table according to the operating point.   |  | 3 phase detailed model with 3D table for flux, torque and inductance.   |  |
| <b>Advantages</b>                            | <ul style="list-style-type: none"> <li>Fast execution: ~ 100 ns</li> <li>Low FPGA resource usage</li> <li>Variable Ld – Lq</li> <li>Good for most operating condition</li> </ul>   |  | <ul style="list-style-type: none"> <li>Simulation of spatial/current harmonics</li> <li>FEA based models</li> <li>Mechanical model on FPGA</li> </ul> |  |
| <b>Disadvantages</b>                         | <ul style="list-style-type: none"> <li>No simulation of current harmonics.</li> </ul>  |  | <ul style="list-style-type: none"> <li>Slower execution: ~ 500 ns</li> <li>High FPGA resource usage</li> </ul>  |  |
| <b>Minimum time step</b>                     | 100 ns   |  | 500 ns  |  |
| <b>Electrical machine parameters</b>         | Constant Ld, Lq and magnet flux.   | 2D tables for Ld, Lq and magnet flux Id and Iq are dependent.            | 3D tables for phase inductance, magnet flux and torque tables Id Iq and are dependent.  |  |
| <b>Mechanical model</b>                      | Basic inertia and friction mechanical model attached to the rotor. Users can define their own model on CPU or through customizing the FPGA   |  |   |  |
| <b>Compatibility with JMAG</b>               | No   |  | JMAG v10.5+   |  |
| <b>Compatibility with ANSYS</b>              | No   |  | ANSYS Maxwell 2016.1+   |  |
| <b>Inductance / torque / flux table size</b> | NA   | <ul style="list-style-type: none"> <li>128x128 for 2 machines</li> </ul> | <ul style="list-style-type: none"> <li>32x16x16 samples for 2 machines</li> <li>32x32x16 samples for 1 machine</li> </ul>                             | <ul style="list-style-type: none"> <li>32x32x32 for 2 machines</li> <li>64x32x32 for 1 machine</li> </ul>  |
| <b>Compatible Hardware Configurations</b>    | <ul style="list-style-type: none"> <li><a href="#">(Archived) Dual_eHSx64_Quad_PMSM_VDQ_IO_Dual_7868R</a></li> <li><a href="#">eHSx64_Dual_PMSM_VDQ_IO_7868R</a></li> <li><a href="#">(Archived) eHSx128_Dual_PMSM_VDQ_IO_7976R</a></li> </ul> |  | <ul style="list-style-type: none"> <li><a href="#">eHSx32_Dual_PMSM_SH_IO_7868R</a></li> </ul>  | <ul style="list-style-type: none"> <li><a href="#">(Archived) eHSx128_Dual_PMSM_SH_IO_7976R</a></li> </ul> |