Validation of GridPACK Powerflow application

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This document provides validation results for the GridPACK™ powerflow application compared against commercial solver of PSS/E. In this document, results from GridPACK™ are compared against three, the IEEE 118 bus system, the Polish system (adapted from MATPOWER), and the European system.

The powerflow algorithm used in GridPACK™ is Newton Raphson AC powerflow. It does not have as many control options as commercial tools at this stage, such as switchable shunt, and tap changer. To have a fair comparison, same solution parameters are used in both GridPACK™ and PSS/E with control logics. The PSS/E solution parameters and loadflow parameters are shown in Figure 1 and Figure 2, respectively.

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| Figure : PSS/E Loadflow parameters | Figure :PSS/E Solution Parameters |

The solution tolerance is 0.001 p.u. (0.1 MW).

# Validation results

## Three test systems, 118-bus, Polish system (3,120-bus), and the European system () are used to perform validation, representing small, medium, and large power systems.

## IEEE 118 bus system:

The voltage magnitude and angle differences between GridPACKTM and PSS/E for the IEEE 118-bus system are shown Figure 3 and Figure 4, respectively. The voltage magnitude solutions are identical between GridPACKTM and PSS/E, while the maximum difference on voltage angle solutions is 0.01 degree, which is well within the acceptable range.

Figure : The Voltage Magnitude Solution Difference between GridPACKTM and PSS/E for the IEEE 118-bus system

Figure : The Voltage Angle Solution Difference between GridPACKTM and PSS/E for the IEEE 118-bus system

## Polish system (adapted from MATPOWER):

The Polish system is adapted from Matpower Matlab package. Figure 5 and Figure 6 show the voltage magnitude and angle differences between GridPACKTM and PSS/E for the Polish system respectively. The maximum difference of voltage magnitude solutions is 0.0009, well under the solution tolerance; the maximum difference on voltage angle solutions is 0.01 degree too, like the IEEE 118-bus case. Such a mismatch is well acceptable considering the solution tolerance of 0.001.

Figure : The Voltage Magnitude Solution Difference between GridPACKTM and PSS/E for the Polish system

Figure : The Voltage Angle Solution Difference between GridPACKTM and PSS/E for the Polish system

## European system

The European system has 13,561 buses, which represents the large power system. Figure 7 shows the voltage magnitude differences between GridPACKTM and PSS/E for the European system. The maximum difference is 0.0001. Figure 8 displays the maximum difference on voltage angle, 0.01 degree. Again, Such a mismatch is well acceptable considering the solution tolerance of 0.001.

Figure : The Voltage Magnitude Solution Difference between GridPACKTM and PSS/E for the European system

Figure : The Voltage Angle Solution Difference between GridPACKTM and PSS/E for the European system

**Conclusions:**

The results shown above that GridPACKTM powerflow solution matches the commercial tool of PSS/E under same solution options. The GridPACK™ powerflow application is validated.