$$V@\gamma_{1,\varphi\_}[k\_] = \varphi\,(1/2 - \overline{p}_k\,\overline{x}_k);\quad V@\gamma_{2,\varphi\_}[k\_] = -\varphi^2\,\overline{p}_k\,\overline{x}_k/2;$$

$$V@\gamma_{3,\varphi\_}[k\_] := -\varphi^3\,\overline{p}_k\,\overline{x}_k/6$$