$$\begin{array}{c|c} \operatorname{Hom}(X,Y) & \xrightarrow{F} & \operatorname{Hom}(FX,FY) \\ \varphi & & \downarrow F^{-1} \\ \\ \operatorname{Hom}(X,Y) & \longleftarrow & \operatorname{Hom}(F^{-1}FX,F^{-1}FY) \\ \\ \nu_Y & \circ - \circ \nu_X^{-1} \end{array}$$