

$$\begin{aligned}
 |\psi_2\rangle = \frac{1}{2} & \left[|00\rangle (\alpha|0\rangle + \beta|1\rangle) + |01\rangle (\alpha|1\rangle + \beta|0\rangle) \right. \\
 & \left. + |10\rangle (\alpha|0\rangle - \beta|1\rangle) + |11\rangle (\alpha|1\rangle - \beta|0\rangle) \right]
 \end{aligned}$$