$$T^{\otimes n}\sum_{g\in\mathcal{G}}|g\rangle=\sum_{g\in\mathcal{G}}\exp\left(\frac{\mathrm{i}\pi|g|}{4}\right)|g\rangle$$
$$=\sum_{h\in\mathcal{G}_0}\sum_{x\in\mathbb{F}_2^{k_T}}\exp\left(\frac{\mathrm{i}\pi}{4}\sum_{a=1}^{k_T}x_a\right)\exp\left(\frac{\mathrm{i}\pi}{2}\left(\sum_{a=1}^{m}x_a\Gamma_a-2\sum_{a<b}x_ax_b\Gamma_{ab}\right)\right)\left|h+\sum_{a=1}^{k_T}x_af^a\right\rangle,$$