$$
\begin{aligned}
\Psi_{51} &= C_1\left(i\left|0duu\right\rangle + \left|duu0\right\rangle - \left|u0du\right\rangle - i\left|uu0d\right\rangle\right) \\
&\quad + C_2\left(-\left|0uud\right\rangle - i\left|d0uu\right\rangle + \left|ud0u\right\rangle + i\left|uud0\right\rangle\right) \\
&\quad + C_3\left(i\left|0udu\right\rangle - i\left|du0u\right\rangle - \left|u0ud\right\rangle + \left|udu0\right\rangle\right) \\
&\quad + C_4\left(-i\left|002u\right\rangle - \left|02u0\right\rangle + i\left|2u00\right\rangle + \left|u002\right\rangle\right) \\
&\quad + C_5\left(-i\left|020u\right\rangle + i\left|0u02\right\rangle - \left|20u0\right\rangle + \left|u020\right\rangle\right) \\
&\quad + C_6\left(\left|00u2\right\rangle - i\left|0u20\right\rangle + i\left|200u\right\rangle - \left|u200\right\rangle\right)
\end{aligned}
$$

$$
C_1 = \frac{\frac{-i}{3}\left(\sqrt{64\,t^4+3\,t^2\,U^2}\left(U-\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)+2\,t^2\left(2\,U+\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)\right)}{\sqrt{2}\,t\left(8\,t^2+\sqrt{64\,t^4+3\,t^2\,U^2}-i\,t\left(U+2\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)\right)}
$$

$$
C_2 = \frac{-48\,i\,t^3+2\,t^2\left(U-4\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)+\sqrt{64\,t^4+3\,t^2\,U^2}\left(-U+\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)-3\,i\,t\left(U^2+2\sqrt{64\,t^4+3\,t^2\,U^2}-U\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)}{6\sqrt{2}\,t\left(8\,t^2+\sqrt{64\,t^4+3\,t^2\,U^2}-i\,t\left(U+2\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)\right)}
$$

$$
C_3 = \frac{48\,t^3+i\sqrt{64\,t^4+3\,t^2\,U^2}\left(U-\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)-2\,i\,t^2\left(-5\,U+2\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)+3\,t\left(U^2+2\sqrt{64\,t^4+3\,t^2\,U^2}-U\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)}{6\sqrt{2}\,t\left(8\,t^2+\sqrt{64\,t^4+3\,t^2\,U^2}-i\,t\left(U+2\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)\right)}
$$

$$
C_4 = \frac{8\,i\,t^2+t\,U+i\sqrt{64\,t^4+3\,t^2\,U^2}}{\sqrt{2}\left(8\,t^2+\sqrt{64\,t^4+3\,t^2\,U^2}-i\,t\left(U+2\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)\right)}
$$

$$
C_5 = \frac{8\,i\,t^2+i\sqrt{64\,t^4+3\,t^2\,U^2}+t\left(U-2\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)}{\sqrt{2}\left(8\,t^2+\sqrt{64\,t^4+3\,t^2\,U^2}-i\,t\left(U+2\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}\right)\right)}
$$

$$
C_6 = \frac{i\sqrt{2}\,t\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}}{8\,i\,t^2+t\,U+i\sqrt{64\,t^4+3\,t^2\,U^2}+2\,t\sqrt{32\,t^2+U^2+4\sqrt{64\,t^4+3\,t^2\,U^2}}}
$$