

$$\begin{aligned}
\mathcal{A}_z^{(1)} &= 2\sqrt{\pi/3}Y_{1,0} \\
\mathcal{A}_y^{(1)} &= i\sqrt{2\pi/3}Y_{1,1} + i\sqrt{2\pi/3}Y_{1,-1} \\
\mathcal{A}_x^{(1)} &= -\sqrt{2\pi/3}Y_{1,1} + \sqrt{2\pi/3}Y_{1,-1} \\
\mathcal{A}_{zz}^{(2)} &= (4/3)\sqrt{\pi/5}Y_{2,0} \\
\mathcal{A}_{yz}^{(2)} &= i\sqrt{2\pi/15}Y_{2,1} + i\sqrt{2\pi/15}Y_{2,-1} \\
\mathcal{A}_{yy}^{(2)} &= -\sqrt{2\pi/15}Y_{2,2} - (2/3)\sqrt{\pi/5}Y_{2,0} - \sqrt{2\pi/15}Y_{2,-2} \\
\mathcal{A}_{xz}^{(2)} &= -\sqrt{2\pi/15}Y_{2,1} + \sqrt{2\pi/15}Y_{2,-1} \\
\mathcal{A}_{xy}^{(2)} &= -i\sqrt{2\pi/15}Y_{2,2} + i\sqrt{2\pi/15}Y_{2,-2} \\
\mathcal{A}_{xx}^{(2)} &= \sqrt{2\pi/15}Y_{2,2} - (2/3)\sqrt{\pi/5}Y_{2,0} + \sqrt{2\pi/15}Y_{2,-2} \\
\mathcal{A}_{zzz}^{(3)} &= (4/5)\sqrt{\pi/7}Y_{3,0} \\
\mathcal{A}_{yzz}^{(3)} &= (4i/5)\sqrt{\pi/21}Y_{3,1} + (4i/5)\sqrt{\pi/21}Y_{3,-1} \\
\mathcal{A}_{yyz}^{(3)} &= -\sqrt{2\pi/105}Y_{3,2} - (2/5)\sqrt{\pi/7}Y_{3,0} - \sqrt{2\pi/105}Y_{3,-2} \\
\mathcal{A}_{yyy}^{(3)} &= -i\sqrt{\pi/35}Y_{3,3} - (i/5)\sqrt{3\pi/7}Y_{3,1} - (i/5)\sqrt{3\pi/7}Y_{3,-1} - i\sqrt{\pi/35}Y_{3,-3} \\
\mathcal{A}_{xzz}^{(3)} &= -(4/5)\sqrt{\pi/21}Y_{3,1} + (4/5)\sqrt{\pi/21}Y_{3,-1} \\
\mathcal{A}_{xyz}^{(3)} &= -i\sqrt{2\pi/105}Y_{3,2} + i\sqrt{2\pi/105}Y_{3,-2} \\
\mathcal{A}_{xyy}^{(3)} &= \sqrt{\pi/35}Y_{3,3} + (1/5)\sqrt{\pi/21}Y_{3,1} - (1/5)\sqrt{\pi/21}Y_{3,-1} - \sqrt{\pi/35}Y_{3,-3} \\
\mathcal{A}_{xxz}^{(3)} &= \sqrt{2\pi/105}Y_{3,2} - (2/5)\sqrt{\pi/7}Y_{3,0} + \sqrt{2\pi/105}Y_{3,-2} \\
\mathcal{A}_{xxy}^{(3)} &= i\sqrt{\pi/35}Y_{3,3} - (i/5)\sqrt{\pi/21}Y_{3,1} - (i/5)\sqrt{\pi/21}Y_{3,-1} + i\sqrt{\pi/35}Y_{3,-3} \\
\mathcal{A}_{xxx}^{(3)} &= -\sqrt{\pi/35}Y_{3,3} + (1/5)\sqrt{3\pi/7}Y_{3,1} - (1/5)\sqrt{3\pi/7}Y_{3,-1} + \sqrt{\pi/35}Y_{3,-3} \\
\mathcal{A}_{zzzz}^{(4)} &= (16/105)\sqrt{\pi}Y_{4,0} \\
\mathcal{A}_{yzzz}^{(4)} &= (4i/21)\sqrt{\pi/5}Y_{4,1} + (4i/21)\sqrt{\pi/5}Y_{4,-1} \\
\mathcal{A}_{yyzz}^{(4)} &= -(2/21)\sqrt{2\pi/5}Y_{4,2} - (8/105)\sqrt{\pi}Y_{4,0} - (2/21)\sqrt{2\pi/5}Y_{4,-2} \\
\mathcal{A}_{yyyz}^{(4)} &= -(i/3)\sqrt{\pi/35}Y_{4,3} - (i/7)\sqrt{\pi/5}Y_{4,1} - (i/7)\sqrt{\pi/5}Y_{4,-1} - (i/3)\sqrt{\pi/35}Y_{4,-3} \\
\mathcal{A}_{yyyy}^{(4)} &= (1/3)\sqrt{2\pi/35}Y_{4,4} + (2/21)\sqrt{2\pi/5}Y_{4,2} + (2/35)\sqrt{\pi}Y_{4,0} + (2/21)\sqrt{2\pi/5}Y_{4,-2} + \\
&\quad (1/3)\sqrt{2\pi/35}Y_{4,-4} \\
\mathcal{A}_{xzzz}^{(4)} &= -(4/21)\sqrt{\pi/5}Y_{4,1} + (4/21)\sqrt{\pi/5}Y_{4,-1} \\
\mathcal{A}_{xyzz}^{(4)} &= -(2i/21)\sqrt{2\pi/5}Y_{4,2} + (2i/21)\sqrt{2\pi/5}Y_{4,-2} \\
\mathcal{A}_{xyyz}^{(4)} &= (1/3)\sqrt{\pi/35}Y_{4,3} + (1/21)\sqrt{\pi/5}Y_{4,1} - (1/21)\sqrt{\pi/5}Y_{4,-1} - (1/3)\sqrt{\pi/35}Y_{4,-3} \\
\mathcal{A}_{xyyy}^{(4)} &= (i/3)\sqrt{2\pi/35}Y_{4,4} + (i/21)\sqrt{2\pi/5}Y_{4,2} - (i/21)\sqrt{2\pi/5}Y_{4,-2} - (i/3)\sqrt{2\pi/35}Y_{4,-4} \\
\mathcal{A}_{xxzz}^{(4)} &= (2/21)\sqrt{2\pi/5}Y_{4,2} - (8/105)\sqrt{\pi}Y_{4,0} + (2/21)\sqrt{2\pi/5}Y_{4,-2} \\
\mathcal{A}_{xyyz}^{(4)} &= (i/3)\sqrt{\pi/35}Y_{4,3} - (i/21)\sqrt{\pi/5}Y_{4,1} - (i/21)\sqrt{\pi/5}Y_{4,-1} + (i/3)\sqrt{\pi/35}Y_{4,-3} \\
\mathcal{A}_{xxxy}^{(4)} &= -(1/3)\sqrt{2\pi/35}Y_{4,4} + (2/105)\sqrt{\pi}Y_{4,0} - (1/3)\sqrt{2\pi/35}Y_{4,-4} \\
\mathcal{A}_{xxxx}^{(4)} &= -(1/3)\sqrt{\pi/35}Y_{4,3} + (1/7)\sqrt{\pi/5}Y_{4,1} - (1/7)\sqrt{\pi/5}Y_{4,-1} + (1/3)\sqrt{\pi/35}Y_{4,-3} \\
\mathcal{A}_{xxx}^{(4)} &= -(i/3)\sqrt{2\pi/35}Y_{4,4} + (i/21)\sqrt{2\pi/5}Y_{4,2} - (i/21)\sqrt{2\pi/5}Y_{4,-2} + (i/3)\sqrt{2\pi/35}Y_{4,-4} \\
\mathcal{A}_{xxx}^{(4)} &= (1/3)\sqrt{2\pi/35}Y_{4,4} - (2/21)\sqrt{2\pi/5}Y_{4,2} + (2/35)\sqrt{\pi}Y_{4,0} - (2/21)\sqrt{2\pi/5}Y_{4,-2} + \\
&\quad (1/3)\sqrt{2\pi/35}Y_{4,-4}
\end{aligned}$$