$$C_{qq}^{(3)\,i1\_i2\_i3\_i4\_} \to \frac{1}{16\,\pi^2}\Big(-\frac{1}{144}\,\frac{1}{m_\Phi{}^2}\,\Big(9\,s_\gamma{}^2\,c_\gamma{}^2\,\overline{y_d}^{i2p}\,\overline{y_d}^{i4r}\,y_d{}^{i1p}\,y_d{}^{i3r} + s_\gamma{}^2\,\overline{y_d}^{i4p}\,\Big(y_d{}^{i3p}\,\Big(18\,c_\gamma{}^2\,\overline{y_u}^{i2r}\,y_u{}^{i1r} + g_2{}^2\,\delta_{i1i2}\Big) + 4\,g_3{}^2\,y_d{}^{i1p}\,\delta_{i2i3}\Big) + c_\gamma{}^2\,\Big(9\,s_\gamma{}^2\,\overline{y_u}^{i2p}\,\overline{y_u}^{i4r}\,y_u{}^{i1p}\,y_u{}^{i3r} + \overline{y_u}^{i4p}\,\Big(g_2{}^2\,y_u{}^{i3p}\,\delta_{i1i2} + 4\,g_3{}^2\,y_u{}^{i1p}\,\delta_{i2i3}\Big)\Big)\Big) + \frac{1}{18}\,g_2{}^4\,LF_{3,0}[m_2]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{12}\,g_2{}^4\,LF_{4,-1}[m_2]\,\delta_{i1i2}\,\delta_{i3i4} - \frac{4}{45}\,g_2{}^4\,LF_{5,-2}[m_2]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{12}\,g_3{}^4\,LF_{3,0}[m_3]\,\delta_{i1i4}\,\delta_{i2i3} + \frac{1}{8}\,g_3{}^4\,LF_{4,-1}[m_3]\,\delta_{i1i4}\,\delta_{i2i3} - \frac{2}{15}\,g_3{}^4\,LF_{5,-2}[m_3]\,\delta_{i1i4}\,\delta_{i2i3} + \frac{1}{36}\sum_p g_3{}^4\,LF_{3,0}\big[m_{\tilde{d}}{}^p\big]\,\delta_{i1i4}\,\delta_{i2i3} - \frac{5}{96}\sum_p g_3{}^4\,LF_{4,-1}\big[m_{\tilde{d}}{}^p\big]\,\delta_{i1i4}\,\delta_{i2i3} + \frac{1}{45}\sum_p g_3{}^4\,LF_{5,-2}\big[m_{\tilde{d}}{}^p\big]\,\delta_{i1i4}\,\delta_{i2i3} + \frac{1}{36}\sum_p g_2{}^4\,LF_{3,0}\big[m_{\tilde{l}}{}^p\big]\,\delta_{i1i2}\,\delta_{i3i4} - \frac{5}{96}\sum_p g_2{}^4\,LF_{4,-1}\big[m_{\tilde{l}}{}^p\big]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{45}\sum_p g_2{}^4\,LF_{5,-2}\big[m_{\tilde{l}}{}^p\big]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{36}\sum_p \big(2\,g_3{}^4\,\delta_{i1i4}\,\delta_{i2i3} + 3\,g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\big)\,LF_{3,0}\big[m_{\tilde{q}}{}^p\big] - \frac{5}{96}\sum_p \big(2\,g_3{}^4\,\delta_{i1i4}\,\delta_{i2i3} + 3\,g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\big)\,LF_{4,-1}\big[m_{\tilde{q}}{}^p\big] + \frac{1}{45}\sum_p \big(2\,g_3{}^4\,\delta_{i1i4}\,\delta_{i2i3} + 3\,g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\big)\,LF_{5,-2}\big[m_{\tilde{q}}{}^p\big] + \frac{1}{36}\sum_p g_3{}^4\,LF_{3,0}\big[m_{\tilde{u}}{}^p\big]\,\delta_{i1i4}\,\delta_{i2i3} - \frac{5}{96}\sum_p g_3{}^4\,LF_{4,-1}\big[m_{\tilde{u}}{}^p\big]\,\delta_{i1i4}\,\delta_{i2i3} + \frac{1}{45}\sum_p g_3{}^4\,LF_{5,-2}\big[m_{\tilde{u}}{}^p\big]\,\delta_{i1i4}\,\delta_{i2i3} + \frac{1}{24}\,\Big(3\,s_\gamma{}^2\,c_\gamma{}^2\,\Big(\overline{y_d}^{i2p}\,\overline{y_d}^{i4r}\,y_d{}^{i1p}\,y_d{}^{i3r} - 2\,\overline{y_d}^{i4p}\,y_d{}^{i3p}\,\overline{y_u}^{i2r}\,y_u{}^{i1r} + \overline{y_u}^{i2p}\,\overline{y_u}^{i4r}\,y_u{}^{i1p}\,y_u{}^{i3r}\Big) - 2\,g_3{}^2\,\Big(s_\gamma{}^2\,\overline{y_d}^{i4p}\,y_d{}^{i1p} + c_\gamma{}^2\,\overline{y_u}^{i4p}\,y_u{}^{i1p}\Big)\,\delta_{i2i3}\Big)\,LF_{1,2}[m_\Phi] + \frac{1}{48}\,\Big(3\,s_\gamma{}^4\,\overline{y_d}^{i2p}\,\overline{y_d}^{i4r}\,y_d{}^{i1p}\,y_d{}^{i3r} + 3\,c_\gamma{}^4\,\overline{y_u}^{i2p}\,\overline{y_u}^{i4r}\,y_u{}^{i1p}\,y_u{}^{i3r} - 2\,g_2{}^2\,c_\gamma{}^2\,\overline{y_u}^{i4p}\,y_u{}^{i3p}\,\delta_{i1i2} + 2\,s_\gamma{}^2\,\overline{y_d}^{i4p}\,y_d{}^{i3p}\,\Big(3\,c_\gamma{}^2\,\overline{y_u}^{i2r}\,y_u{}^{i1r} - g_2{}^2\,\delta_{i1i2}\Big)\Big)\,LF_{2,1}[m_\Phi] + \frac{1}{72}\,g_2{}^2\,\Big(3\,s_\gamma{}^2\,\overline{y_d}^{i4p}\,y_d{}^{i3p} + 3\,c_\gamma{}^2\,\overline{y_u}^{i4p}\,y_u{}^{i3p} + 2\,g_2{}^2\,\delta_{i3i4}\Big)\,LF_{3,0}[m_\Phi]\,\delta_{i1i2} - \frac{5}{96}\,g_2{}^4\,LF_{4,-1}[m_\Phi]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{45}\,g_2{}^4\,LF_{5,-2}[m_\Phi]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{36}\,g_2{}^4\,LF_{3,0}[\tilde{\mu}]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{24}\,g_2{}^4\,LF_{4,-1}[\tilde{\mu}]\,\delta_{i1i2}\,\delta_{i3i4} - \frac{2}{45}\,g_2{}^4\,LF_{5,-2}[\tilde{\mu}]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{432}\,g_1{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,1,0}\big[m_1, m_{\tilde{q}}{}^{i4}\big] + \frac{1}{432}\,g_1{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,2,-1}\big[m_1, m_{\tilde{q}}{}^{i4}\big] - \frac{1}{216}\,g_1{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{3,1,-1}\big[m_1, m_{\tilde{q}}{}^{i4}\big] + \frac{1}{432}\,g_1{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{4,1,-2}\big[m_1, m_{\tilde{q}}{}^{i4}\big] + \frac{1}{48}\,\Big(3\,g_2{}^2\,g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} - g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,1,0}\big[m_2, m_{\tilde{q}}{}^{i4}\big] + \frac{1}{48}\,\Big(3\,g_2{}^2\,g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} - g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,2,-1}\big[m_2, m_{\tilde{q}}{}^{i4}\big] - \frac{1}{24}\,g_2{}^2\,\Big(3\,g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + 5\,g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{3,1,-1}\big[m_2, m_{\tilde{q}}{}^{i4}\big] + \frac{1}{16}\,\Big(g_2{}^2\,g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{4,1,-2}\big[m_2, m_{\tilde{q}}{}^{i4}\big] - \frac{1}{72}\,g_3{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} - 8\,g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,1,0}\big[m_3, m_{\tilde{q}}{}^{i4}\big] - \frac{1}{72}\,g_3{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} - 8\,g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,2,-1}\big[m_3, m_{\tilde{q}}{}^{i4}\big] - \frac{1}{72}\,g_3{}^2\,\Big(25\,g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + 16\,g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{3,1,-1}\big[m_3, m_{\tilde{q}}{}^{i4}\big] + \frac{1}{9}\,\Big(g_3{}^4\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^2\,g_3{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{4,1,-2}\big[m_3, m_{\tilde{q}}{}^{i4}\big] - \frac{1}{12}\,g_3{}^2\,\overline{y_d}^{i4p}\,y_d{}^{i1p}\,LF_{2,1,0}\big[m_{\tilde{d}}{}^p, \tilde{\mu}\big]\,\delta_{i2i3} + \frac{1}{24}\,g_3{}^2\,\overline{y_d}^{i4p}\,y_d{}^{i1p}\,LF_{2,2,-1}\big[m_{\tilde{d}}{}^p, \tilde{\mu}\big]\,\delta_{i2i3} + \frac{1}{24}\,g_3{}^2\,\overline{y_d}^{i4p}\,y_d{}^{i1p}\,LF_{3,1,-1}\big[m_{\tilde{d}}{}^p, \tilde{\mu}\big]\,\delta_{i2i3} - \frac{1}{216}\,g_1{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,1,0}\big[m_{\tilde{q}}{}^{i4}, m_1\big] + \frac{1}{432}\,g_1{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{3,1,-1}\big[m_{\tilde{q}}{}^{i4}, m_1\big] + \frac{1}{24}\,\Big(-3\,g_2{}^2\,g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} + g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,1,0}\big[m_{\tilde{q}}{}^{i4}, m_2\big] + \frac{1}{48}\,\Big(3\,g_2{}^2\,g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} - g_2{}^4\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{3,1,-1}\big[m_{\tilde{q}}{}^{i4}, m_2\big] + \frac{1}{36}\,\Big(g_3{}^4\,\delta_{i1i4}\,\delta_{i2i3} - 8\,g_2{}^2\,g_3{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{2,1,0}\big[m_{\tilde{q}}{}^{i4}, m_3\big] - \frac{1}{72}\,g_3{}^2\,\Big(g_3{}^2\,\delta_{i1i4}\,\delta_{i2i3} - 8\,g_2{}^2\,\delta_{i1i2}\,\delta_{i3i4}\Big)\,LF_{3,1,-1}\big[m_{\tilde{q}}{}^{i4}, m_3\big] - \frac{1}{12}\,g_3{}^2\,\overline{y_u}^{i4p}\,y_u{}^{i1p}\,LF_{2,1,0}\big[m_{\tilde{u}}{}^p, \tilde{\mu}\big]\,\delta_{i2i3} + \frac{1}{24}\,g_3{}^2\,\overline{y_u}^{i4p}\,y_u{}^{i1p}\,LF_{2,2,-1}\big[m_{\tilde{u}}{}^p, \tilde{\mu}\big]\,\delta_{i2i3} + \frac{1}{24}\,g_3{}^2\,\overline{y_u}^{i4p}\,y_u{}^{i1p}\,LF_{3,1,-1}\big[m_{\tilde{u}}{}^p, \tilde{\mu}\big]\,\delta_{i2i3} + \frac{1}{24}\,g_3{}^2\,\overline{y_d}^{i4p}\,y_d{}^{i1p}\,LF_{2,1,0}\big[\tilde{\mu}, m_{\tilde{d}}{}^p\big] - \frac{1}{24}\,\overline{y_d}^{i4p}\,\Big(3\,g_2{}^2\,y_d{}^{i3p}\,\delta_{i1i2} + 2\,g_3{}^2\,y_d{}^{i1p}\,\delta_{i2i3}\Big)\,LF_{3,1,-1}\big[\tilde{\mu}, m_{\tilde{d}}{}^p\big] + \frac{1}{24}\,\overline{y_d}^{i4p}\,\Big(g_2{}^2\,y_d{}^{i3p}\,\delta_{i1i2} + g_3{}^2\,y_d{}^{i1p}\,\delta_{i2i3}\Big)\,LF_{4,1,-2}\big[\tilde{\mu}, m_{\tilde{d}}{}^p\big] + \frac{1}{24}\,g_3{}^2\,\overline{y_u}^{i4p}\,y_u{}^{i1p}\,LF_{2,1,0}\big[\tilde{\mu}, m_{\tilde{u}}{}^p\big]\,\delta_{i2i3} - \frac{1}{24}\,\overline{y_u}^{i4p}\,\Big(3\,g_2{}^2\,y_u{}^{i3p}\,\delta_{i1i2} + 2\,g_3{}^2\,y_u{}^{i1p}\,\delta_{i2i3}\Big)\,LF_{3,1,-1}\big[\tilde{\mu}, m_{\tilde{u}}{}^p\big] + \frac{1}{24}\,\overline{y_u}^{i4p}\,\Big(g_2{}^2\,y_u{}^{i3p}\,\delta_{i1i2} + g_3{}^2\,y_u{}^{i1p}\,\delta_{i2i3}\Big)\,LF_{4,1,-2}\big[\tilde{\mu}, m_{\tilde{u}}{}^p\big] + \frac{1}{16}\,g_2{}^4\,LF_{2,1,1,-1}\big[m_2, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i2}\big]\,\delta_{i1i2}\,\delta_{i3i4} - \frac{1}{8}\,g_2{}^4\,m_2{}^2\,LF_{2,1,1,0}\big[m_2, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i2}\big]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{7}{48}\,g_3{}^4\,LF_{2,1,1,-1}\big[m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i3}\big]\,\delta_{i1i4}\,\delta_{i2i3} - \frac{1}{12}\,g_3{}^4\,m_3{}^2\,LF_{2,1,1,0}\big[m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i3}\big]\,\delta_{i1i4}\,\delta_{i2i3} - \frac{1}{4}\,\tilde{\mu}^2\,\overline{y_d}^{i4p}\,y_d{}^{i3p}\,\overline{y_u}^{i2r}\,y_u{}^{i1r}\,LF_{2,1,1,0}\big[\tilde{\mu}, m_{\tilde{d}}{}^p, m_{\tilde{u}}{}^r\big] + \frac{1}{16}\,\overline{y_d}^{i2p}\,\overline{y_d}^{i4r}\,y_d{}^{i1p}\,y_d{}^{i3r}\,LF_{2,1,1,-1}\big[\tilde{\mu}, m_{\tilde{d}}{}^r, m_{\tilde{d}}{}^p\big] + \frac{1}{16}\,\overline{y_u}^{i2p}\,\overline{y_u}^{i4r}\,y_u{}^{i1p}\,y_u{}^{i3r}\,LF_{2,1,1,-1}\big[\tilde{\mu}, m_{\tilde{u}}{}^r, m_{\tilde{u}}{}^p\big] + \frac{1}{144}\,g_1{}^2\,g_2{}^2\,LF_{1,1,1,1,-1}\big[m_1, m_2, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i2}\big]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{72}\,m_1\,m_2\,g_1{}^2\,g_2{}^2\,LF_{1,1,1,1,0}\big[m_1, m_2, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i2}\big]\,\delta_{i1i2}\,\delta_{i3i4} + \frac{1}{144}\,g_1{}^2\,g_3{}^2\,LF_{1,1,1,1,-1}\big[m_1, m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i3}\big]\,\delta_{i1i4}\,\delta_{i2i3} + \frac{1}{72}\,m_1\,m_3\,g_1{}^2\,g_3{}^2\,LF_{1,1,1,1,0}\big[m_1, m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i3}\big]\,\delta_{i1i4}\,\delta_{i2i3} - \frac{1}{24}\,g_2{}^2\,g_3{}^2\,LF_{1,1,1,1,-1}\big[m_2, m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i2}\big]\,\delta_{i1i2}\,\delta_{i3i4} - \frac{1}{12}\,m_2\,m_3\,g_2{}^2\,g_3{}^2\,LF_{1,1,1,1,0}\big[m_2, m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i2}\big]\,\delta_{i1i2}\,\delta_{i3i4} - \frac{1}{16}\,g_2{}^2\,g_3{}^2\,LF_{1,1,1,1,-1}\big[m_2, m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i3}\big]\,\delta_{i1i4}\,\delta_{i2i3} - \frac{1}{8}\,m_2\,m_3\,g_2{}^2\,g_3{}^2\,LF_{1,1,1,1,0}\big[m_2, m_3, m_{\tilde{q}}{}^{i4}, m_{\tilde{q}}{}^{i3}\big]\,\delta_{i1i4}\,\delta_{i2i3}\Big)$$