The third term in (17-120) is (where the last line uses (4-148), pg. 122, $\gamma^{\mu\dagger}\gamma^0 = \gamma^0\gamma^\mu$)

$$\frac{1}{4}\sum_{spins}\mathcal{M}_{B1}\mathcal{M}_{B2}^{*} = \underbrace{\frac{-e^4}{\left(p_2 - p_2'\right)^2\left(p_1 + p_2\right)^2}}_{\left(\Gamma_1\Gamma_2^{*}\right)}\frac{1}{4}\sum_{spins}\left\{\begin{array}{c}\left(\bar{u}_{s_1'}(\mathbf{p}_1')\gamma_\mu v_{s_2'}(\mathbf{p}_2')\bar{v}_{s_2}(\mathbf{p}_2)\gamma^\mu u_{s_1}(\mathbf{p}_1)\right)\times \\ \underbrace{\left(\bar{u}_{s_1'}(\mathbf{p}_1')\gamma_\nu u_{s_1}(\mathbf{p}_1)\bar{v}_{s_2}(\mathbf{p}_2)\gamma^\nu v_{s_2'}(\mathbf{p}_2')\right)^{*}}_{\left(\bar{u}_{s_1'}(\mathbf{p}_1')\gamma_\nu u_{s_1}(\mathbf{p}_1)\right)^\dagger\left(\bar{v}_{s_2}(\mathbf{p}_2)\gamma^\nu v_{s_2'}(\mathbf{p}_2')\right)^\dagger}\end{array}\right\} \quad (17\text{-}123)$$

Third term in (17-120) *more complicated*

$$= \left(\Gamma_1\Gamma_2^{*}\right)\frac{1}{4}\sum_{spins}\left\{\begin{array}{c}\left(\bar{u}_{s_1'\,\beta}(\mathbf{p}_1')\left(\gamma_\mu\right)_{\beta\delta}v_{s_2'\,\delta}(\mathbf{p}_2')\bar{v}_{s_2\,\varepsilon}(\mathbf{p}_2)\left(\gamma^\mu\right)_{\varepsilon\eta}u_{s_1\,\eta}(\mathbf{p}_1)\right)\times \\ \left(\bar{u}_{s_1\,\kappa}(\mathbf{p}_1)\left(\gamma_\nu\right)_{\kappa\lambda}u_{s_1'\,\lambda}(\mathbf{p}_1')\bar{v}_{s_2'\,\rho}(\mathbf{p}_2')\left(\gamma^\nu\right)_{\rho\xi}v_{s_2\,\xi}(\mathbf{p}_2)\right)\end{array}\right\}.$$