$$u = \sqrt{1-v\overset{*}{v}}\,\zeta\sqrt{1-\overline{v}\overset{+}{v}}: \quad \zeta = \sqrt{1-v\overset{*}{v}}^{-1}u\,\sqrt{1-\overline{v}\overset{+}{v}}^{-1}$$

$$\sqrt{1-v\overset{*}{v}}^{\,+} = \sqrt{1-\overline{v}\overset{+}{v}}: \quad \sqrt{1-\overset{+}{v}\overline{v}}^{\,+} = \sqrt{1-\overset{*}{v}v}$$

$$\overset{+}{\zeta} = \sqrt{1-\overline{v}\overset{+}{v}}^{\,+^{-1}}\overset{+}{u}\,\sqrt{1-v\overset{*}{v}}^{\,+^{-1}} = -\sqrt{1-v\overset{*}{v}}^{-1}u\,\sqrt{1-\overline{v}\overset{+}{v}}^{-1} = -\zeta$$

$$\frac{1\;\big|\;0}{0\;\big|\;1} - \frac{u\;\big|\;v}{-\overset{+}{v}\;\big|\;0}\;\frac{\overset{*}{u}\;\big|\;-\overline{v}}{\overset{*}{v}\;\big|\;0} = \frac{\sqrt{1-v\overset{*}{v}}\;\Big|\;0}{0\;\Big|\;\sqrt{1-\overset{+}{v}\overline{v}}}\;\frac{1\;\big|\;\zeta\overline{v}}{0\;\big|\;1}\;\frac{1-\zeta\overset{*}{\zeta}\;\big|\;0}{0\;\big|\;1}\;\frac{1\;\big|\;0}{\overset{+}{v}\zeta\;\big|\;1}\;\frac{\sqrt{1-v\overset{*}{v}}\;\Big|\;0}{0\;\Big|\;\sqrt{1-\overset{+}{v}\overline{v}}}$$

$$\sqrt{1-v\overset{*}{v}}\left(1-\zeta\overset{*}{\zeta}+\zeta\overline{v}\overset{+}{v}\zeta\right)\sqrt{1-v\overset{*}{v}} = 1-v\overset{*}{v}-\sqrt{1-v\overset{*}{v}}\,\zeta\left(1-\overline{v}\overset{+}{v}\right)\overset{*}{\zeta}\sqrt{1-v\overset{*}{v}} = 1-v\overset{*}{v}-u\overset{*}{u}$$

$$\sqrt{1-v\overset{*}{v}}\,\zeta\,\overline{v}\sqrt{1-\overset{+}{v}\overline{v}} = \sqrt{1-v\overset{*}{v}}\,\zeta\sqrt{1-\overline{v}\overset{+}{v}}\,\overline{v} = u\,\overline{v}$$

$$\Rightarrow \; \text{RHS} \; = \; \frac{\sqrt{1-v\overset{*}{v}}\left(1-\zeta\overset{*}{\zeta}+\zeta\overline{v}\overset{+}{v}\zeta\right)\sqrt{1-v\overset{*}{v}}}{\sqrt{1-\overset{+}{v}\overline{v}}\overset{+}{v}\overset{*}{\zeta}\sqrt{1-v\overset{*}{v}}}\;\Bigg|\;\frac{\sqrt{1-v\overset{*}{v}}\,\zeta\overline{v}\sqrt{1-\overset{+}{v}\overline{v}}}{1-\overset{+}{v}\overline{v}} \; = \; \frac{1-u\overset{*}{u}-v\overset{*}{v}\;\Big|\;u\overline{v}}{\overset{+}{v}\overset{*}{u}\;\Big|\;1-\overset{+}{v}\overline{v}} \; = \; \text{LHS}$$

$$\frac{1\;\big|\;0}{0\;\big|\;1} - \frac{\overset{*}{u}\;\big|\;-\overline{v}}{\overset{*}{v}\;\big|\;0}\;\frac{u\;\big|\;v}{-\overset{+}{v}\;\big|\;0} = \frac{\sqrt{1-\overline{v}\overset{+}{v}}\;\Big|\;0}{0\;\Big|\;\sqrt{1-\overset{*}{v}v}}\;\frac{1\;\big|\;-\overset{*}{\zeta}v}{0\;\big|\;1}\;\frac{1-\overset{*}{\zeta}\zeta\;\big|\;0}{0\;\big|\;1}\;\frac{1\;\big|\;0}{-\overset{*}{v}\zeta\;\big|\;1}\;\frac{\sqrt{1-\overline{v}\overset{+}{v}}\;\Big|\;0}{0\;\Big|\;\sqrt{1-\overset{*}{v}v}}$$

$$\overbrace{\frac{u\;\big|\;v}{-\overset{+}{v}\;\big|\;0}\;\frac{\overset{*}{u}\;\big|\;-\overline{v}}{\overset{*}{v}\;\big|\;0}}^{+} = \frac{\overset{*}{u}\;\big|\;-\overline{v}}{\overset{*}{v}\;\big|\;0}^{+}\;\frac{u\;\big|\;v}{-\overset{+}{v}\;\big|\;0}^{+} = \frac{\overline{u}\;\big|\;\overline{v}}{-\overline{v}\;\big|\;0}\;\frac{\overset{+}{u}\;\big|\;-v}{\overset{+}{v}\;\big|\;0} = \frac{-\overset{*}{u}\;\big|\;\overline{v}}{-\overset{*}{v}\;\big|\;0}\;\frac{-u\;\big|\;-v}{\overset{+}{v}\;\big|\;0} = \frac{\overset{*}{u}\;\big|\;-\overline{v}}{\overset{*}{v}\;\big|\;0}\;\frac{u\;\big|\;v}{-\overset{+}{v}\;\big|\;0}$$

$$\frac{1\;\big|\;\zeta\overline{v}}{0\;\big|\;1}^{+} = \frac{1\;\big|\;0}{\overset{+}{v}\zeta\;\big|\;1}^{+} = \frac{1\;\big|\;0}{-\overset{*}{v}\zeta\;\big|\;1}: \quad \frac{1\;\big|\;0}{\overset{+}{v}\overset{*}{\zeta}\;\big|\;1}^{+} = \frac{1\;\big|\;\overline{\zeta}v}{0\;\big|\;1} = \frac{1\;\big|\;-\overset{*}{\zeta}v}{0\;\big|\;1}$$

$$
\begin{array}{c|c} u & v \\ \hline -\overset{+}{v} & 0 \end{array} \, B_{\begin{array}{c|c} u & v \\ \hline -\overset{+}{v} & 0 \end{array}} \;=\; \begin{array}{c|c} 0 & v \\ \hline -\overset{+}{v} & 0 \end{array} \, B^{1/2}_{\begin{array}{c|c} 0 & v \\ \hline -\overset{+}{v} & 0 \end{array}} \; A \begin{array}{c|c} \zeta & 0 \\ \hline 0 & 0 \end{array} B_{\begin{array}{c|c} \zeta & 0 \\ \hline 0 & 0 \end{array}} \; A^* \begin{array}{c|c} 0 & v \\ \hline -\overset{+}{v} & 0 \end{array} \, B^{1/2}_{\begin{array}{c|c} 0 & v \\ \hline -\overset{+}{v} & 0 \end{array}}
$$

$$
A \begin{array}{c|c} x & y \\ \hline -\overset{+}{y} & 0 \end{array} \;=\; \begin{array}{c|c} 1 & \zeta\bar{v} \\ \hline 0 & 1 \end{array} \begin{array}{c|c} x & y \\ \hline -\overset{+}{y} & 0 \end{array} \begin{array}{c|c} 1 & 0 \\ \hline -\overset{*}{v}\zeta & 1 \end{array} \;:\quad A^* \begin{array}{c|c} x & y \\ \hline -\overset{+}{y} & 0 \end{array} \;=\; \begin{array}{c|c} 1 & 0 \\ \hline \overset{*}{\overset{+}{v}}\zeta & 1 \end{array} \begin{array}{c|c} x & y \\ \hline -\overset{+}{y} & 0 \end{array} \begin{array}{c|c} 1 & -\overset{*}{\zeta}v \\ \hline 0 & 1 \end{array}
$$

$$
A = \exp\left(-2\zeta\overset{*}{\overset{\text{\Large ✱}}{v}}\right) = B_{\zeta:v}
$$

$$
2\zeta\overset{\text{\Large ✱}}{v}z = \zeta\overset{*}{v}z + z\overset{*}{v}\zeta = \begin{array}{c|c} \zeta & 0 \\ \hline 0 & 0 \end{array} \begin{array}{c|c} 0 & \overset{*}{v} \\ \hline -\overset{+}{v} & 0 \end{array} z + z \begin{array}{c|c} 0 & \overset{*}{v} \\ \hline -\overset{+}{v} & 0 \end{array} \begin{array}{c|c} \zeta & 0 \\ \hline 0 & 0 \end{array}
$$

$$
= \begin{array}{c|c} \zeta & 0 \\ \hline 0 & 0 \end{array} \begin{array}{c|c} 0 & \overset{*}{-\bar{v}} \\ \hline \overset{*}{v} & 0 \end{array} z + z \begin{array}{c|c} 0 & \overset{*}{-\bar{v}} \\ \hline \overset{*}{v} & 0 \end{array} \begin{array}{c|c} \zeta & 0 \\ \hline 0 & 0 \end{array} = \begin{array}{c|c} 0 & -\zeta\bar{v} \\ \hline 0 & 0 \end{array} z + z \begin{array}{c|c} 0 & 0 \\ \hline \overset{*}{v}\zeta & 0 \end{array}
$$

$$
\Rightarrow \exp 2\zeta\overset{\text{\Large ✱}}{v} = \begin{array}{c|c} 1 & -\zeta\bar{v} \\ \hline 0 & 1 \end{array} z \begin{array}{c|c} 1 & 0 \\ \hline \overset{*}{v}\zeta & 1 \end{array}
$$