$$i\overbrace{k\cdot P}\curlywedge\overbrace{k\cdot X}=k\cdot k$$
$$i\overbrace{k^{\mu}\underset{\mu\nu}{\eta}P^{\nu}}\curlywedge\overbrace{k^{\alpha}\underset{\alpha\beta}{\eta}X^{\beta}}=k^{\mu}\underset{\mu\nu}{\eta}k^{\nu}$$

$$i\,P^{\mu}\curlywedge X^{\nu}=\overset{\mu\nu}{\eta}$$
$$\text{LHS}=k^{\mu}\underset{\mu\nu}{\eta}k^{\alpha}\underset{\alpha\beta}{\eta}i\,P^{\nu}\curlywedge X^{\beta}=k^{\mu}\underset{\mu\nu}{\eta}k^{\alpha}\underset{\alpha\beta}{\eta}\overset{\nu\beta}{\eta}=k^{\mu}\underset{\mu\nu}{\eta}k^{\alpha}\overset{\nu}{\underset{\alpha}{\delta}}=\text{RHS}$$

$${}^{k\cdot Xi}\mathfrak{e}=\exp k^{\mu}\underset{\mu\nu}{\eta}X^{\nu}i$$

$${}^{x}k=\exp k^{\mu}\underset{\mu\nu}{\eta}\underbrace{X^{\nu}i+P^{\nu x}\not{\epsilon}}=\begin{cases}\mathfrak{e}^{k\cdot Xi}x^{k\cdot(P+k/2)}\\ x^{k\cdot(P-k/2)}\mathfrak{e}^{k\cdot Xi}\end{cases}$$

$$A\curlywedge B\text{ scalar}\implies{}^{A+B}\mathfrak{e}={}^{A}\mathfrak{e}\,{}^{B}\mathfrak{e}\,{}^{-A\curlywedge B/2}\mathfrak{e}\implies{}^{-B}\mathfrak{e}\,{}^{-A}\mathfrak{e}\,{}^{A+B}\mathfrak{e}={}^{-A\curlywedge B/2}\mathfrak{e}$$
$$x^{-k\cdot P}\,\mathfrak{e}^{-k\cdot Xi}\ \text{LHS}=\mathfrak{e}^{-k\cdot P^{x}\not{\epsilon}}\,\mathfrak{e}^{-k\cdot Xi}\,\mathfrak{e}^{k\cdot\left(Xi+P^{x}\not{\epsilon}\right)}=\mathfrak{e}^{-i\overbrace{k\cdot X}\curlywedge\overbrace{k\cdot P}^{x}\not{\epsilon}/2}=\mathfrak{e}^{k\cdot k^{x}\not{\epsilon}/2}=\sqrt[k^{2}]{x}$$
$$\mathfrak{e}^{-k\cdot Xi}\,x^{-k\cdot P}\ \text{LHS}=\mathfrak{e}^{-k\cdot P^{x}\not{\epsilon}}\,\mathfrak{e}^{-k\cdot P^{x}\not{\epsilon}}\,\mathfrak{e}^{k\cdot\left(Xi+P^{x}\not{\epsilon}\right)}=\mathfrak{e}^{-i\overbrace{k\cdot P}\curlywedge\overbrace{k\cdot X}^{x}\not{\epsilon}/2}=\mathfrak{e}^{-k\cdot k^{x}\not{\epsilon}/2}=\sqrt[-k^{2}]{x}$$

$${}^{Xi}\mathfrak{e}^{k}\sqrt[P^{2}]{x}=\sqrt[\overbrace{P-k}^{2}]{x}\,{}^{Xi}\mathfrak{e}^{k}$$

$$\sqrt[P^{2}]{x}\,{}^{Xi}\mathfrak{e}^{k}\sqrt[-P^{2}]{x}={}^{k\cdot\left(Xi+P^{x}\not{\epsilon}\right)}\mathfrak{e}={}^{Xi}\mathfrak{e}^{k\,k\cdot P^{x}\not{\epsilon}}\mathfrak{e}\,{}^{-i\overbrace{k\cdot X}\curlywedge\overbrace{k\cdot P}^{x}\not{\epsilon}/2}\mathfrak{e}={}^{Xi}\mathfrak{e}^{k\,k\cdot P^{x}\not{\epsilon}}\mathfrak{e}\,{}^{k\cdot k^{x}\not{\epsilon}/2}\mathfrak{e}={}^{Xi}\mathfrak{e}^{k}\,x^{k\cdot P}\sqrt[k^{2}]{x}$$
$$\sqrt[P^{2}]{x}\,{}^{Xi}\mathfrak{e}^{k}={}^{Xi}\mathfrak{e}^{k}\,x^{k\cdot P}\sqrt[k^{2}]{x}\sqrt[P^{2}]{x}={}^{Xi}\mathfrak{e}^{k}\sqrt[(k^{2}+P)]{x}$$
$$\sqrt[P^{2}]{x}\,{}^{Xi}\mathfrak{e}^{-k}={}^{Xi}\mathfrak{e}^{-k}\sqrt[\overbrace{P-k}^{2}]{x}$$

$$ {}^{x_1}_{1}V\ {}^{x_1x_2}_{2}V\ ..\ {}^{x_1x_2..x_m}_{m}V\ \sqrt{x_1x_2..x_m}^{P^2} = \sqrt{x_1}^{P^2}_{1}V\ \sqrt{x_2}^{P^2}_{2}V\ ..\ \sqrt{x_m}^{P^2}_{m}V $$

$$ \text{LHS} = \sqrt{x_1}^{P^2}_{1}V\ \sqrt{x_1}^{-P^2}\sqrt{x_1x_2}^{P^2}_{2}V\ \sqrt{x_1x_2}^{-P^2}..\sqrt{x_1x_2..x_m}^{P^2}_{m}V\ \sqrt{x_1x_2..x_m}^{-P^2}\sqrt{x_1x_2..x_m}^{P^2} = \text{RHS} $$

$$ \sqrt{x_1}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_1}\ \sqrt{x_2}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_2}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}\ \sqrt{x_3}^{\overbrace{P-k_1-k_2}^{2}}..\sqrt{x_m}^{\overbrace{P-k_1-k_2-..-k_{m-1}}^{2}} $$

$$ \sqrt{x_1}^{P^2}\underbrace{Xi_{\mathfrak{e}}{}^{k_1}\sqrt{x_2}^{P^2}}\ Xi_{\mathfrak{e}}{}^{k_2}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} = \sqrt{x_1}^{P^2}\underbrace{\sqrt{x_2}^{\overbrace{P-k_1}^{2}}Xi_{\mathfrak{e}}{}^{k_1}}\ Xi_{\mathfrak{e}}{}^{k_2}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}\underbrace{Xi_{\mathfrak{e}}{}^{k_1}Xi_{\mathfrak{e}}{}^{k_2}}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}\ Xi_{\mathfrak{e}}{}^{k_1+k_2}\ \sqrt{x_3}^{P^2}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}\ \underbrace{Xi_{\mathfrak{e}}{}^{k_1+k_2}\sqrt{x_3}^{P^2}}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}\ \underbrace{\sqrt{x_3}^{\overbrace{P-k_1-k_2}^{2}}Xi_{\mathfrak{e}}{}^{k_1+k_2}}\ Xi_{\mathfrak{e}}{}^{k_3}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}\ \sqrt{x_3}^{\overbrace{P-k_1-k_2}^{2}}\ \underbrace{Xi_{\mathfrak{e}}{}^{k_1+k_2}Xi_{\mathfrak{e}}{}^{k_3}}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}\ \sqrt{x_3}^{\overbrace{P-k_1-k_2}^{2}}\ Xi_{\mathfrak{e}}{}^{k_1+k_2+k_3}..\sqrt{x_m}^{P^2}\ Xi_{\mathfrak{e}}{}^{k_m} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}..\sqrt{x_{m-1}}^{\overbrace{P-k_1-k_2-..-k_{m-2}}^{2}}\ \underbrace{Xi_{\mathfrak{e}}{}^{k_1+k_2+..+k_{m-1}}\sqrt{x_m}^{P^2}}\ Xi_{\mathfrak{e}}{}^{k_m} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}..\sqrt{x_{m-1}}^{\overbrace{P-k_1-k_2-..-k_{m-2}}^{2}}\ \underbrace{\sqrt{x_m}^{\overbrace{P-k_1-..-k_{m-1}-k_m}^{2}}Xi_{\mathfrak{e}}{}^{k_1+k_2+..+k_{m-1}}}\ Xi_{\mathfrak{e}}{}^{k_m} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}..\sqrt{x_{m-1}}^{\overbrace{P-k_1-k_2-..-k_{m-2}}^{2}}\ \sqrt{x_m}^{\overbrace{P-k_1-..-k_{m-1}-k_m}^{2}}\ \underbrace{Xi_{\mathfrak{e}}{}^{k_1+k_2+..+k_{m-1}}Xi_{\mathfrak{e}}{}^{k_m}} $$

$$ = \sqrt{x_1}^{P^2}\ \sqrt{x_2}^{\overbrace{P-k_1}^{2}}..\sqrt{x_{m-1}}^{\overbrace{P-k_1-k_2-..-k_{m-2}}^{2}}\ \sqrt{x_m}^{\overbrace{P-k_1-..-k_{m-1}-k_m}^{2}}\ \underbrace{Xi_{\mathfrak{e}}{}^{k_1+k_2+..+k_{m-1}+k_m}}_{=1} $$