By the dispersion relation $k = \dfrac{\omega_p}{c}\sqrt{\dfrac{\omega}{\omega_B}}$, the phase velocity is

$$v_p = \frac{\omega}{k} = \frac{\omega}{\dfrac{\omega_p}{c}\sqrt{\dfrac{\omega}{\omega_B}}} = \frac{\sqrt{\omega\omega_B}}{\omega_p}c.$$

In term of k, $\omega = \dfrac{c^2k^2\omega_B}{\omega_p^2}$. The group velocity is

$$v_g = \frac{\mathrm{d}\omega}{\mathrm{d}k} = \frac{2c^2k\omega_B}{\omega_p^2} = \frac{2c^2\omega_B}{\omega_p^2}\cdot\frac{\omega_p}{c}\sqrt{\frac{\omega}{\omega_B}} = 2\frac{\sqrt{\omega\omega_B}}{\omega_p}c.$$

Hence, $v_g = 2v_p$.

Remark:
$\dfrac{\mathrm{d}\omega}{\mathrm{d}k} = \left(\dfrac{\mathrm{d}k}{\mathrm{d}\omega}\right)^{-1}$ may be used, since the dispersion relation is bijective (inverse function exists) and differentiable for the domain $\omega > 0$. Thus, for $k = f(\omega)$ and $\omega = f^{-1}(k) = f^{-1}(f(\omega))$,

$$\frac{\mathrm{d}\omega}{\mathrm{d}\omega} = 1 = \frac{\mathrm{d}f^{-1}(f(\omega))}{\mathrm{d}\omega} = \underbrace{\frac{\mathrm{d}f^{-1}}{\mathrm{d}f}}_{=\frac{\mathrm{d}\omega}{\mathrm{d}k}}\cdot\underbrace{\frac{\mathrm{d}f(\omega)}{\mathrm{d}\omega}}_{=\frac{\mathrm{d}k}{\mathrm{d}\omega}}.$$

and $\dfrac{\mathrm{d}\omega}{\mathrm{d}k} = \left(\dfrac{\mathrm{d}k}{\mathrm{d}\omega}\right)^{-1}$.