2.30 Show that at the position where the magnitude of the voltage on the line is a maximum, the input impedance is purely real.

Solution: From Eq. (2.70), $d_{\max} = (\theta_r + 2n\pi)/2\beta$, so from Eq. (2.61), using polar representation for Γ,

$$Z_{in}(d_{\max}) = Z_0 \left(\frac{1 + |\Gamma| \exp j\theta_r \exp -j2\beta l_{\max}}{1 - |\Gamma| \exp j\theta_r \exp -j2\beta l_{\max}} \right)$$
$$= Z_0 \left(\frac{1 + |\Gamma| \exp j\theta_r \exp -j(\theta_r + 2n\pi)}{1 - |\Gamma| \exp j\theta_r \exp -j(\theta_r + 2n\pi)} \right) = Z_0 \left(\frac{1 + |\Gamma|}{1 - |\Gamma|} \right),$$

which is real, provided Z_0 is real.