

22-13. Two overstress possibilities, overvoltage across drain-source terminals because of stray inductance and excessive power dissipation. Check for overvoltage first.

$$V_{DS(\text{turn-off})} = V_d + L \frac{di}{dt} = 100 + (10^{-7}) \left[\frac{100}{5 \times 10^{-8}} \right] = 300 \text{ V} > BV_{DSS} = 150 \text{ V}$$

Check for excessive power dissipation.

$$P_{\text{allowed}} = \frac{T_{j,\text{max}} - T_a}{R_{\theta j-a}} = \frac{150 - 50}{1} = 100 \text{ watts} ; P_{\text{dissipated}} = [E_{\text{on}} + E_{\text{sw}}] f_s$$

$$E_{\text{on}} f_s = \frac{I_o^2 R_{DS(\text{on})}}{2} = \frac{(100)^2 (0.01)}{2} = 50 \text{ watts}$$

$$E_{\text{sw}} = \frac{V_d I_o}{2} [t_{ri} + t_{fi} + t_{rv} + t_{fv}] = \frac{(100)(100)}{2} [(2)(5 \times 10^{-8}) + (2)(2 \times 10^{-7})]$$

$$E_{\text{sw}} = 2.5 \times 10^{-3} \text{ joules} ; E_{\text{sw}} f_s = (2.5 \times 10^{-3})(3 \times 10^4) = 75 \text{ watts}$$

$$P_{\text{dissipated}} = 50 + 75 = 125 \text{ watts} > P_{\text{allowed}} = 100 \text{ watts}$$

MOSFET overstressed by both overvoltages and excessive power dissipation.