

23.1

Because of inductive kickback;
when the motor is turned off, the magnetic field in the coils (inductor) is dissipated by generating a large voltage to account for the sudden lack of current.
Can destroy switching element that is not designed for high voltages.

$$\left(V = L \cdot \frac{di}{dt} \right)$$

23.2

1. you can't hear it above 20kHz
2. lower torque ripple
3. lower current ripple
4. more linear duty cycle / speed relationship.

$$\underline{23.10}$$

$$k_T = 1.657 \text{ Nm/A}$$

$$k_e = 1.230 \text{ V/krpm}$$

$$R = 20.3 \text{ } \Omega$$

$$V = 14 \text{ V}$$

$$T_{\text{load}} = 0.15 \text{ Nm}$$

$$\text{duty cycle} = 25\% / 85\%$$

find ω

$$W = W_{NL} - R_m \cdot T$$

$$= \frac{V}{k_e} - \frac{R}{k_e k_t} \cdot T$$

for 25% d.c.:

$$V = 0.25 \cdot V_s$$

$$= 0.25 \cdot 14 \text{ V}$$

$$= 3.5 \text{ V}$$

$$= \frac{3.5 \text{ V}}{1.230 \text{ V/krpm}} - \frac{20.3 \text{ } \Omega \cdot 0.15 \text{ Nm}}{1.657 \text{ Nm/A} \cdot 1.230 \text{ V/krpm}}$$

$$= \boxed{1351 \text{ rpm}} \quad @ 25\% \text{ d.c.}$$

$$@ 85\%, V = 0.85 \cdot 14 \text{ V} = 11.9 \text{ V}$$

$$\omega = \frac{11.9 \text{ V}}{1.230 \text{ V/krpm}} - \frac{20.3 \text{ } \Omega \cdot 0.15 \text{ Nm}}{1.657 \text{ Nm/A} \cdot 1.230 \text{ V/krpm}}$$

$$= \boxed{818 \text{ rpm}}$$