A Guide to Braking Resistor Calculation

Control Panel Products Ltd 2016
Variable Speed Drive (Inverter) Circuit

Diode Rectifier

DC Bus

Inverter

Electric Motor

Supply
DC “Bus”

\[ DC = 1.35 \times \text{Supply AC} \]

Supply Power

Generating

Regenerating
Braking Circuit (Chopper & Resistor)

Supply

Diode Rectifier or HV Battery

Inverter

Electric Motor

Current Flow under braking
**DC Bus Voltage**

\[ V_{dc} = V_{ac \text{ rms}} \times \sqrt{2} \]

Due to Diode Rectifier losses, figure usually quoted is \( V_{ac \text{ rms}} \times 1.35 \) for B6 rectifier

Braking Resistors are typically activated at \( @125\% \times V_{dc} \)

Therefore Braking circuit activation voltage is \( V_{dc} \times 1.25 \)

For 230Vrms drive;

DC Bus Voltage is \( 230 \times 1.35 = 310.5 \text{ Vdc} \)

Braking Circuit Activation Voltage is \( 310.5 \times 1.25 = 388 \text{ Vdc} \)
Calculating Braking Resistor Value

\[ R = \left( \frac{V_{dc\ Switch-On}}{P_{peak}} \right)^2 \]

\[ P_{peak} = \text{Motor Power Rating} \times \text{Maximum Torque} \times \text{Efficiency} \]

- Motor Power Rating; use drive power rating if unknown
- Maximum Torque typically 100 to 200\% \textit{(use 1.5 if unknown)}
- Motor Efficiency typically 0.8 to 0.98 \textit{(use 0.95 if unknown)}
- Drive Efficiency typically 0.9 to 0.98 \textit{(use 0.95 if unknown)}

For a 230V 2.2KW Drive with unknowns

\[ R = \left( \frac{230 \times 1.35 \times 1.25}{2200 \times 1.5 \times 0.95 \times 0.95} \right)^2 = 150641.016 = 51\Omega \]
Duty Cycle

• Duty Cycle = What proportion of a given time period is the braking circuit activated?

• For situations where a motor is required to accelerate and decelerate frequently e.g. A passenger lift, this will be quite high; 50% = 0.5

• For situations where a motor is required to maintain a steady speed e.g. A pump or Fan motor, this will be quite low; 5% = 0.05
Calculating Braking Resistor Power

\[ P = P_{\text{peak}} \times \sqrt{\text{Duty Cycle}} \times 0.5 \]

- \( P_{\text{peak}} = \) Motor Power Rating \( \times \) Maximum Torque \( \times \) Efficiency
- Motor Power Rating; use drive power rating if unknown
- Maximum Torque typically 100 to 200\% \((\text{use 1.5 if unknown})\)
- Motor Efficiency typically 0.8 to 0.98 \((\text{use 0.95 if unknown})\)
- Drive Efficiency typically 0.9 to 0.98 \((\text{use 0.95 if unknown})\)

For a 2.2KW Drive with 40\% duty cycle and unknowns

\[ P_{\text{peak}} = (2200 \times 1.5 \times 0.95 \times 0.95)\sqrt{0.4} \times 0.5 \]

\[ = 2978.25 \times \sqrt{0.2} \]

\[ = 1332 \text{ W} \]
Calculating Braking Resistor Power (Simple Version)

\[ P = \text{Motor Power} \times \text{Max Torque} \times \text{Duty Cycle} \]

- Motor Power Rating; use drive power rating if unknown
- Maximum Torque typically 100 to 200\% (use 1.5 if unknown)

For a 2.2KW Drive with 40\% duty cycle and unknowns

\[ P = 2200 \times 1.5 \times 0.4 \]

\[ = 1320 \text{ W} \]
Calculating Braking Unit (Chopper) Current

\[ I_{\text{peak}} = \sqrt{P_{\text{peak}} / R} \]

- \( P_{\text{peak}} = \) Motor Power Rating x Maximum Torque x Efficiency
- Motor Power Rating; use drive power rating if unknown
- Maximum Torque typically 100 to 200% \((use 1.5 if unknown)\)
- Motor Efficiency typically 0.8 to 0.98 \((use 0.95 if unknown)\)
- Drive Efficiency typically 0.9 to 0.98 \((use 0.95 if unknown)\)

For a 230V 2.2KW Drive with unknowns

\[ I_{\text{peak}} = \sqrt{2200 \times 1.5 \times 0.95 \times 0.95 / 51} = 7.642A \]