Design 2: Peak vs RMS Current

TI Precision Labs – Motor Drivers

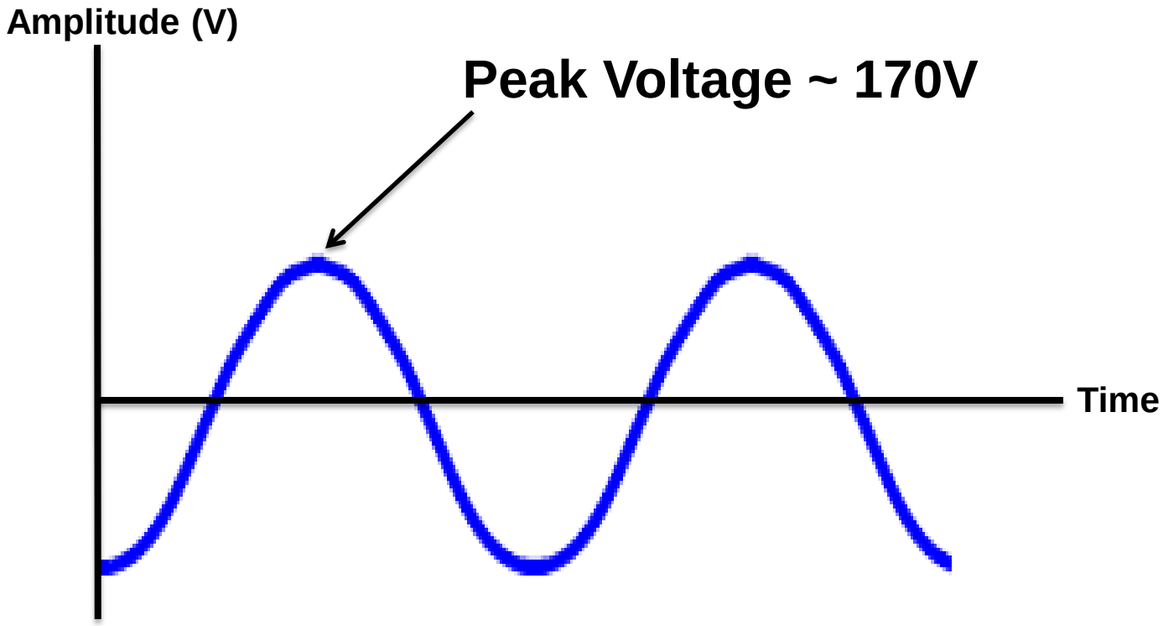
Presented and Prepared by Anthony Lodi

Overview

- What is peak current?
- What is RMS current?
- Why is peak current important?
- What role does RMS current play in driving a motor?
- RMS current in Brushed, Stepper, and Brushless DC motors
- Current protection features

RMS vs. peak current: an example

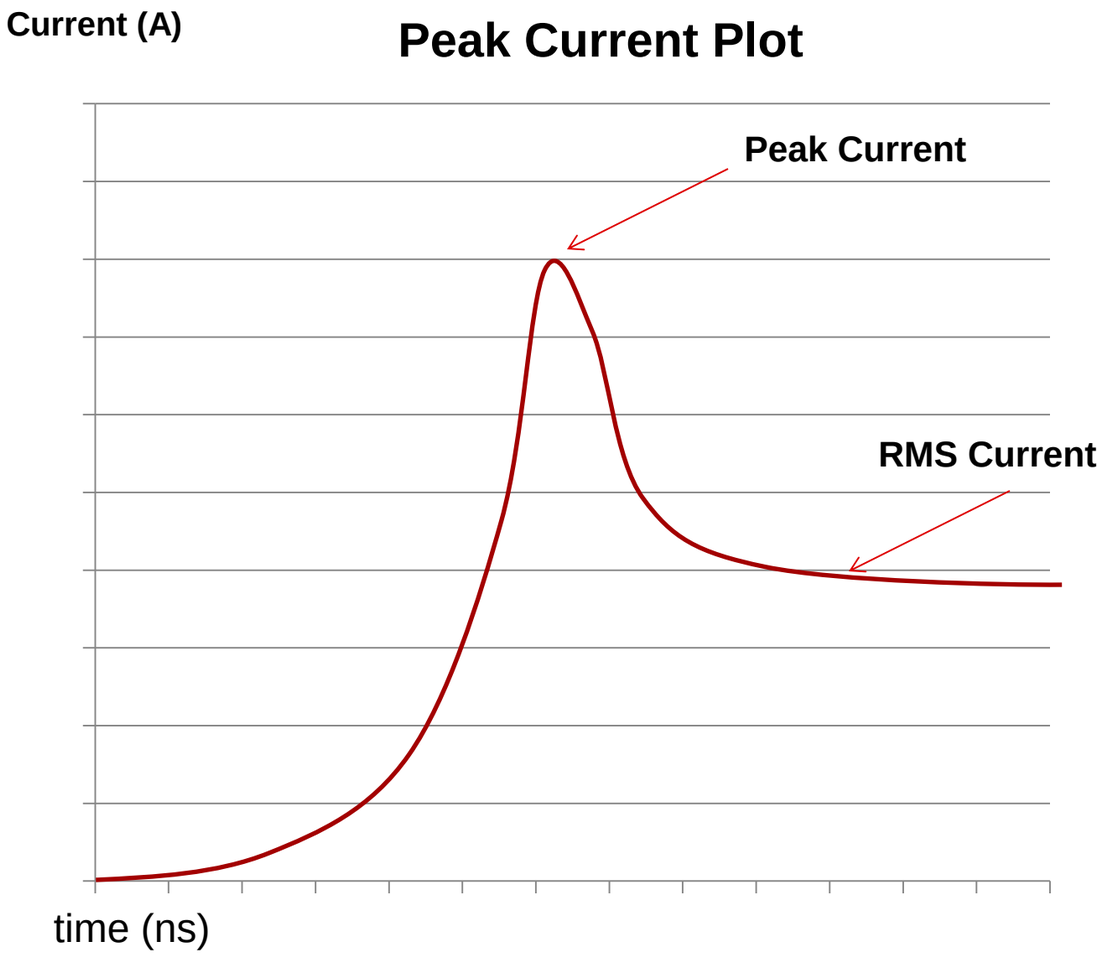
- Wall outlet in United States is 120V AC
- Voltage actually alternates between about +/- 170V
- Root Mean Squared (RMS) value is 120V
- Peak value is 170V



What is peak current and what is RMS current?

- Peak current is the maximum current at a given time
- RMS current is the average current over time

$$Power = (RMS\ Current)^2 \times Resistance$$

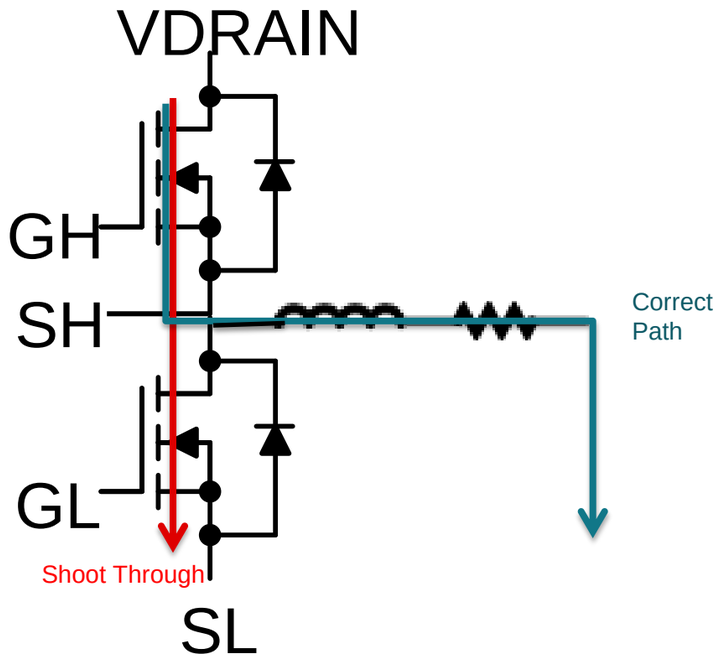


Why is peak current important?

- Current spikes are common when driving a motor

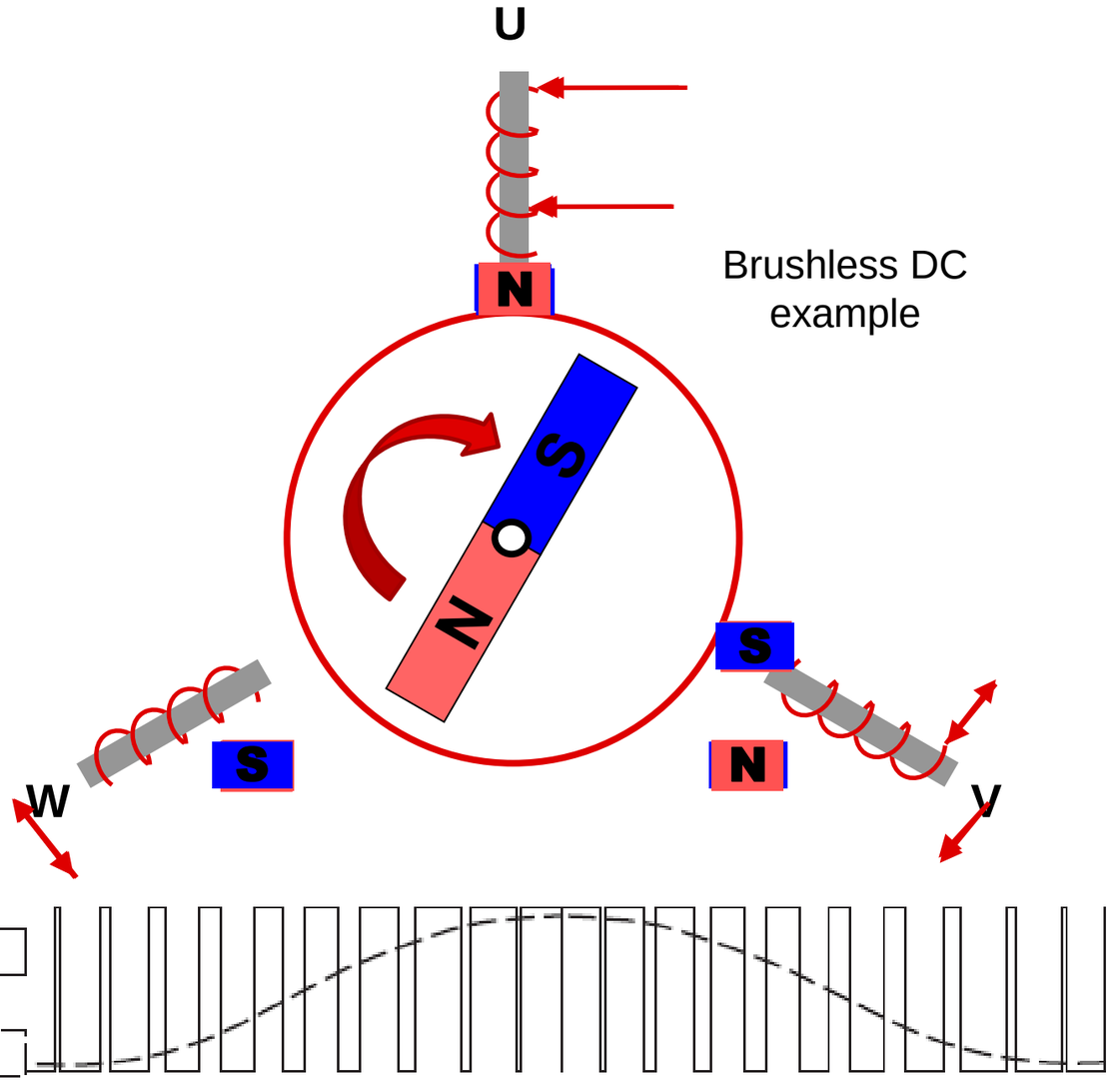
- Current spikes can potentially damage equipment
  - Shoot through or external short
  - Rotor lockup
  - Startup

- It is important to monitor these events to prevent damage



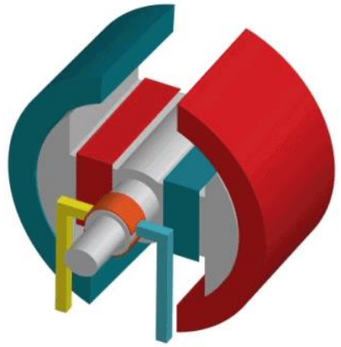
What role does RMS current play in driving a motor?

- The current through the stator of the motor produces a magnetic field to perform commutation
- The current through the stators of the motor is related to the torque of the motor
- PWM signals used to adjust the average current flow

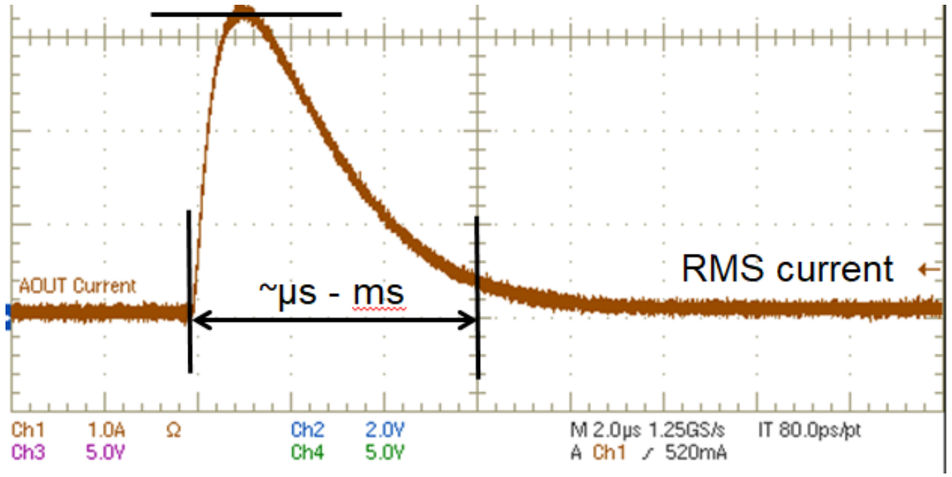


RMS current in brushed motors

- Brushed-DC motor drivers use pulse width modulation to adjust the current supplied to the motor to change the torque and speed.



- To find out more info on Brushed-DC motors and motor control, visit the *Motor Drivers: Brushed-DC Motors* section of this training series

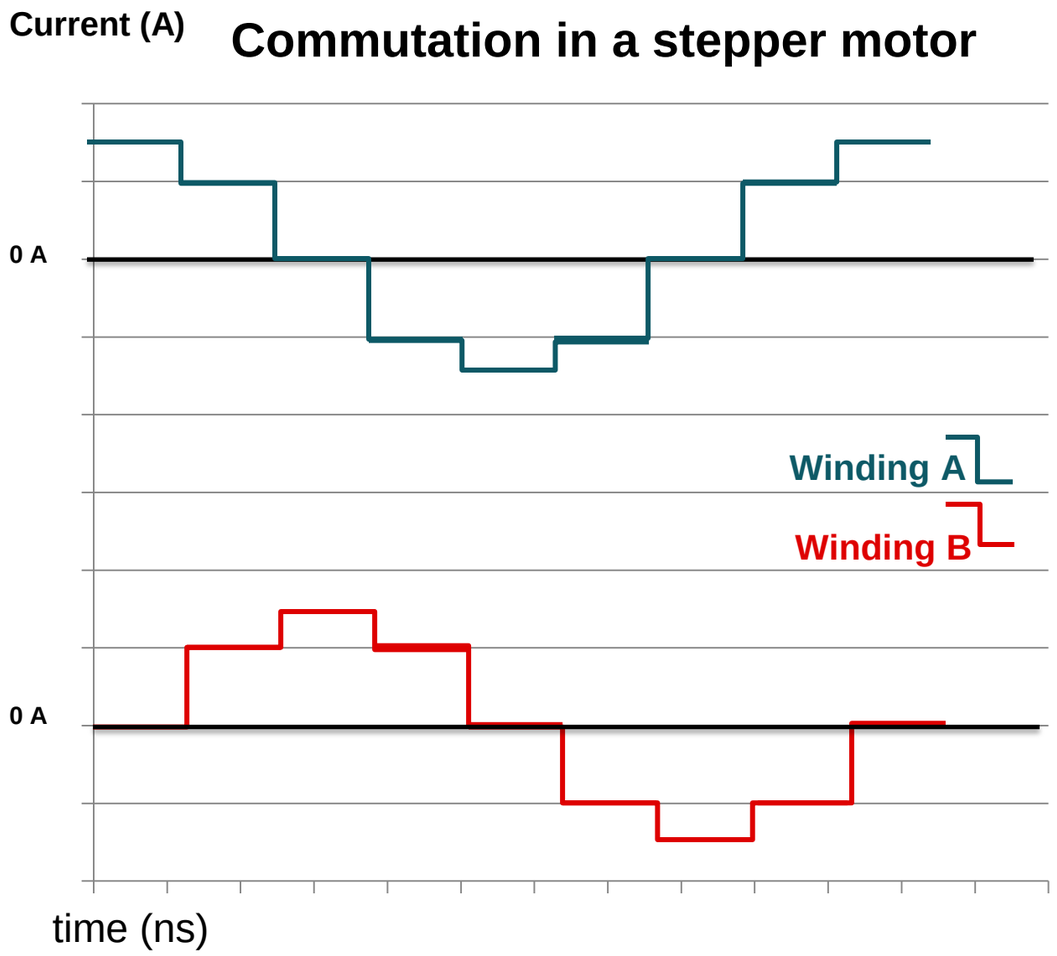


Startup current transitioning to RMS current in a Brushed DC motor

RMS current in stepper motors

- Stepper motors step through different current levels in each stator winding to achieve the desired rotor position

- To find out more info on stepper motor commutation and the importance of current, visit the *Motor Drivers: Stepper Motors* section of this training series

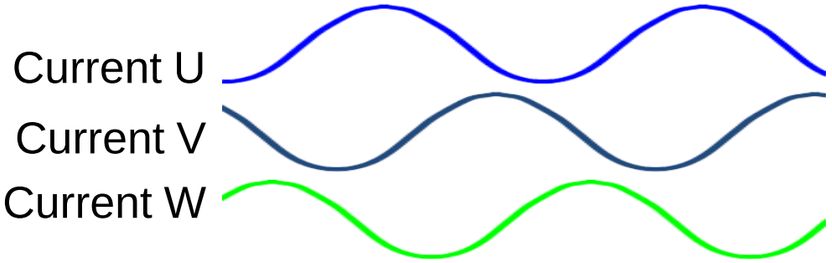


RMS current in brushless DC motors

- Trapezoidal vs. Sinusoidal commutation generally uses different current waveforms to perform commutation

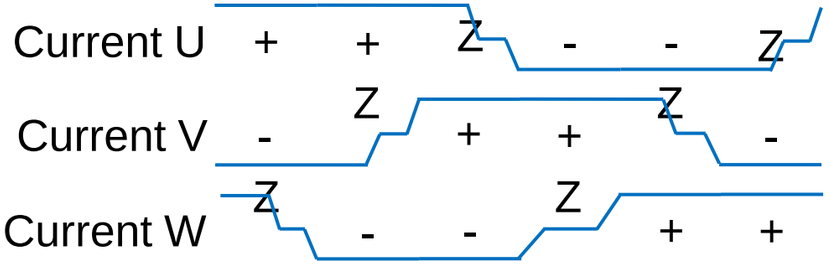
- To find out more info on Brushless DC (BLDC) motor commutation and the importance of current, visit the *Motor Drivers: Brushless-DC Motors* section of this training series

Sinusoidal Drive current



$$\textbf{\textit{Sinusoidal RMS Current}} = \frac{\textbf{\textit{Peak Current}}}{\sqrt{2}}$$

Trapezoidal Drive Current



Current protection features

- Overcurrent protection
- Thermal protection
- For more information on the safety features that are available in in TI motor drivers, visit the *Motor Drivers: Motor Technology* section of this presentation series

To find more motor driver technical resources and search products, visit ti.com/motordrivers