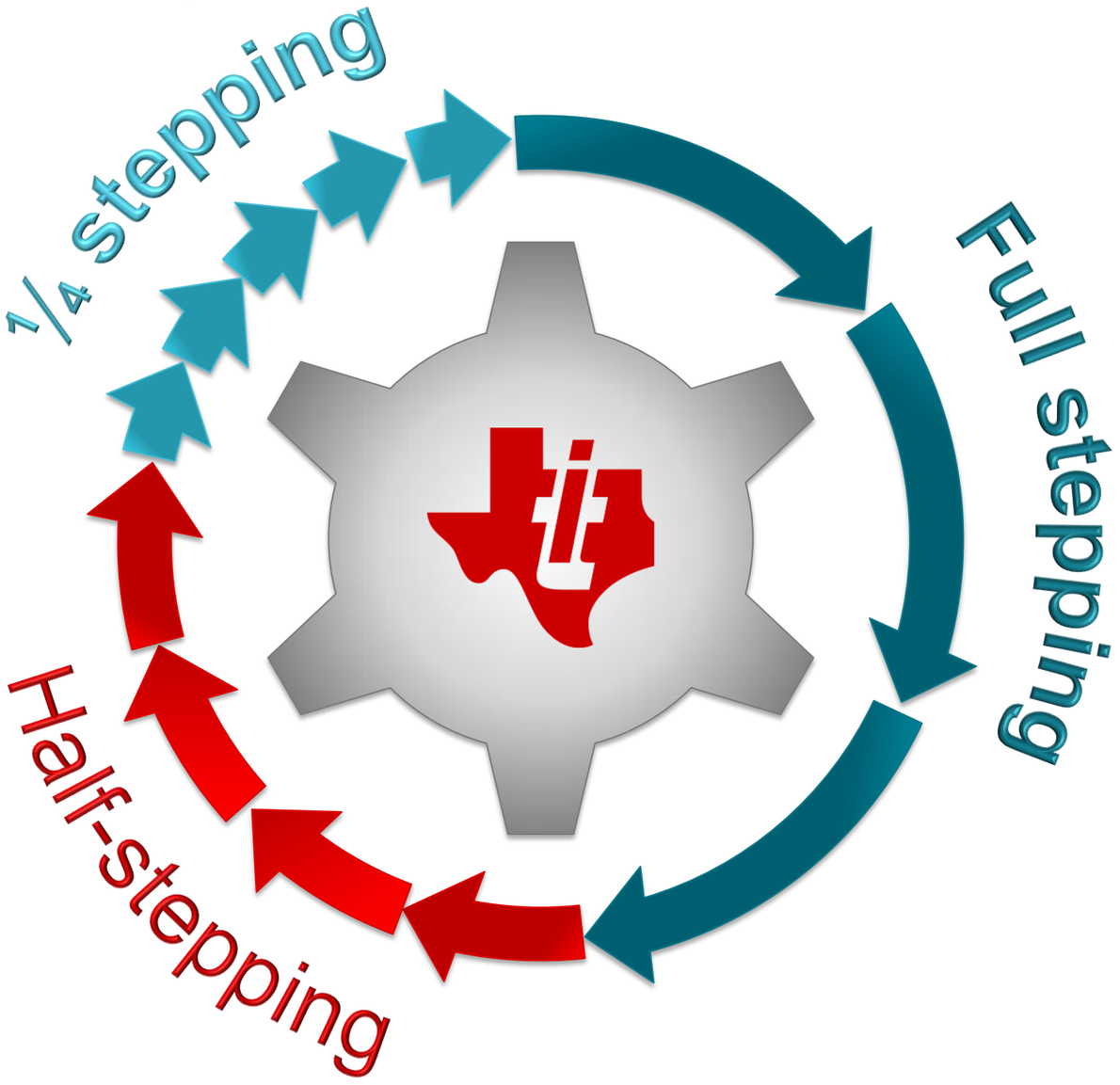
Stepper Motor 3: Microstepping In Bipolar Stepper Motors

TI Precision Labs – Motor Drivers

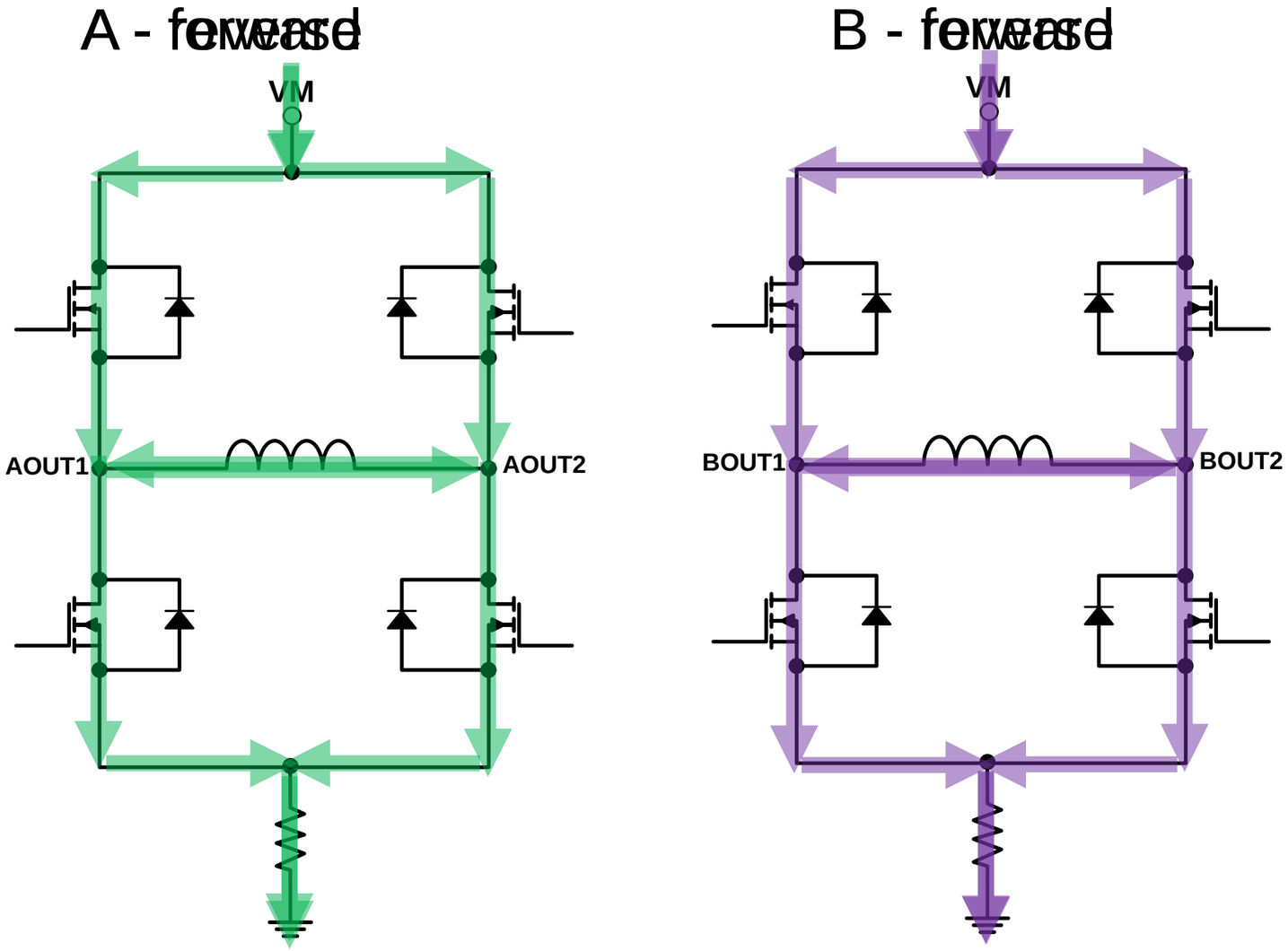
Presented and prepared by James Lockridge

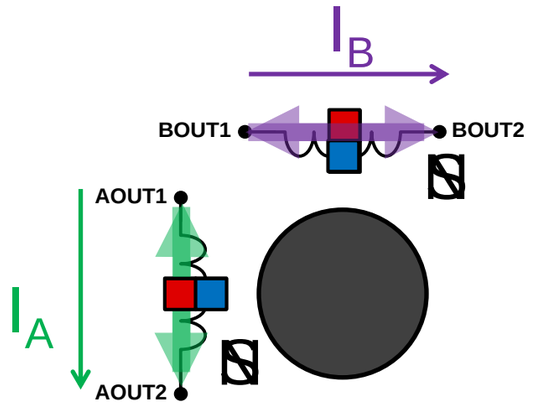
The advantage of microstepping

- Precise positioning
- Smooth motion
- Can sub-divide step size down to 1/256

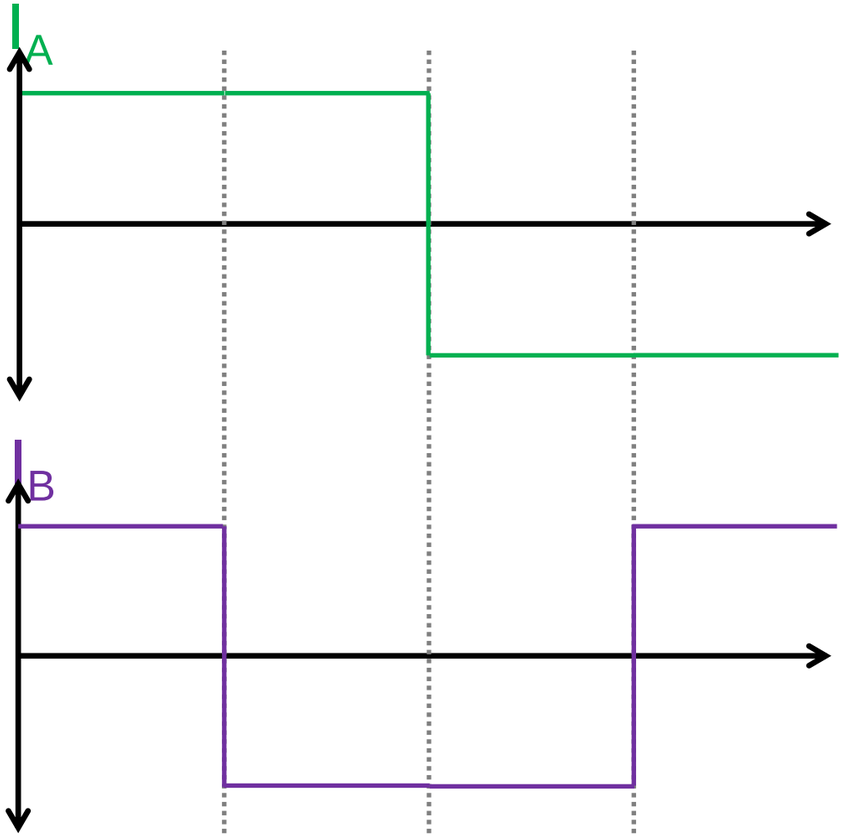


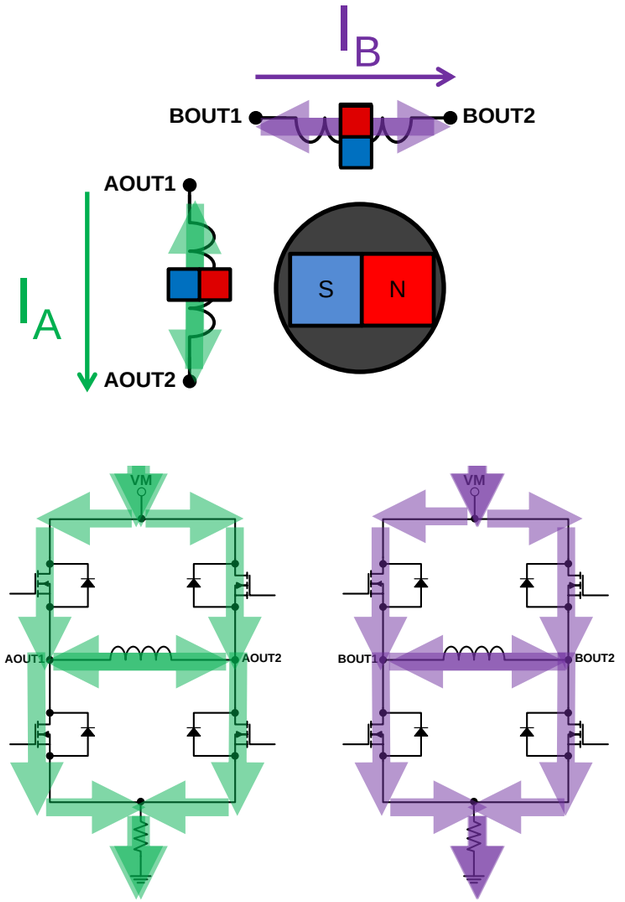
Stator magnetic field produced by windings



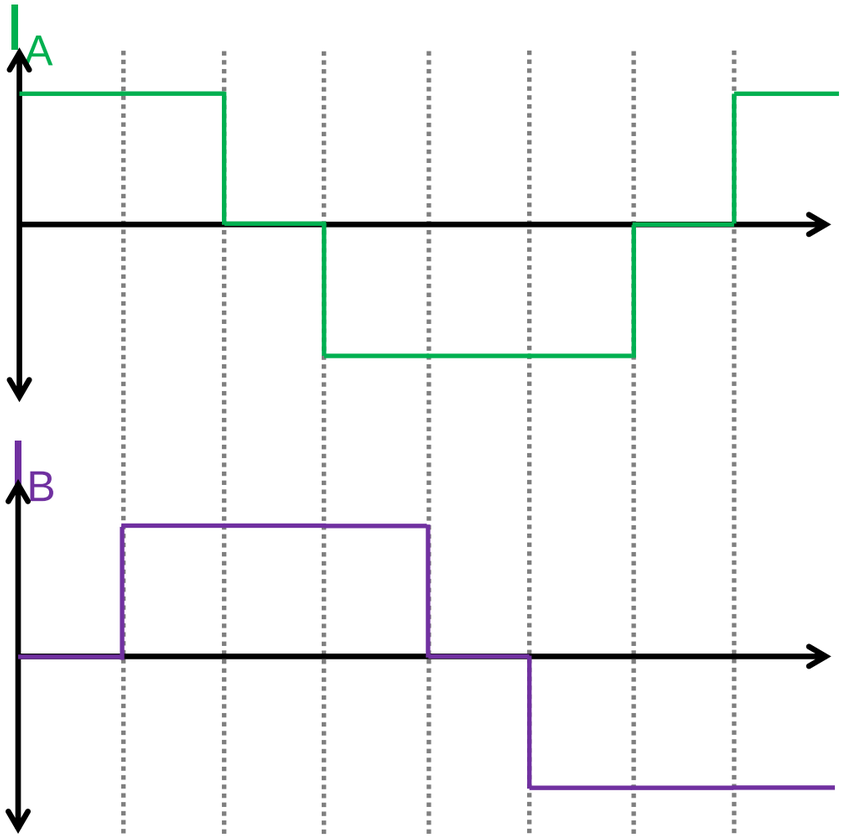


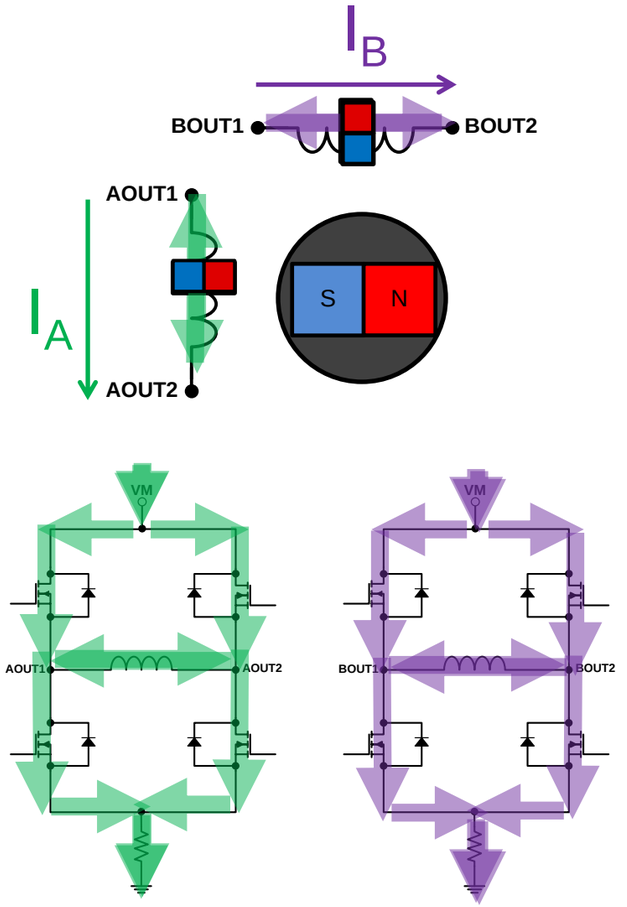
Full stepping



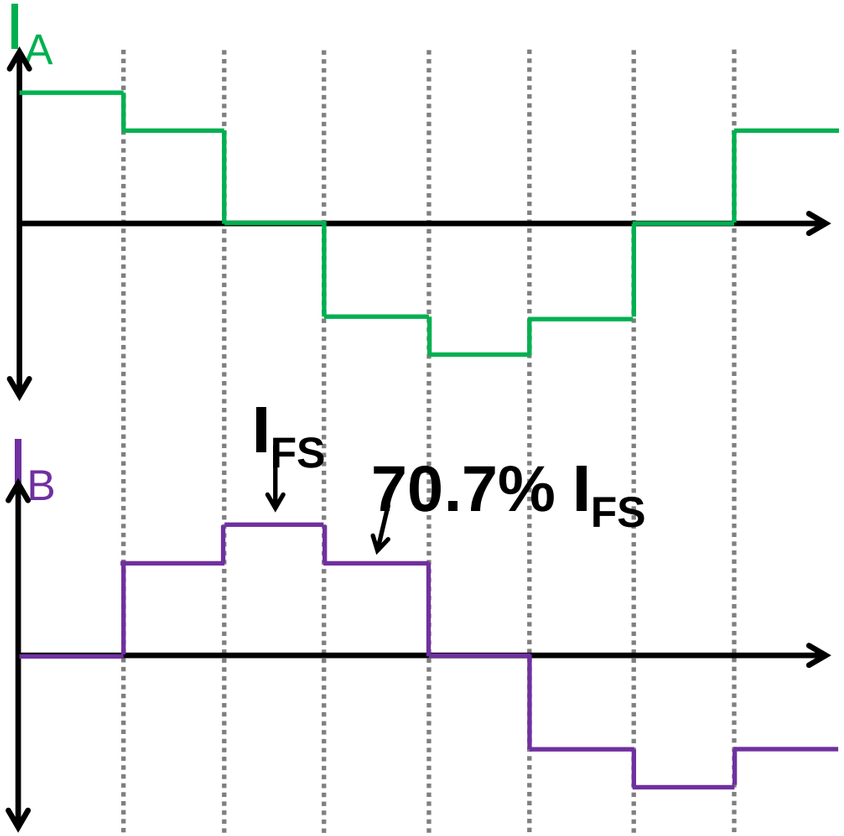


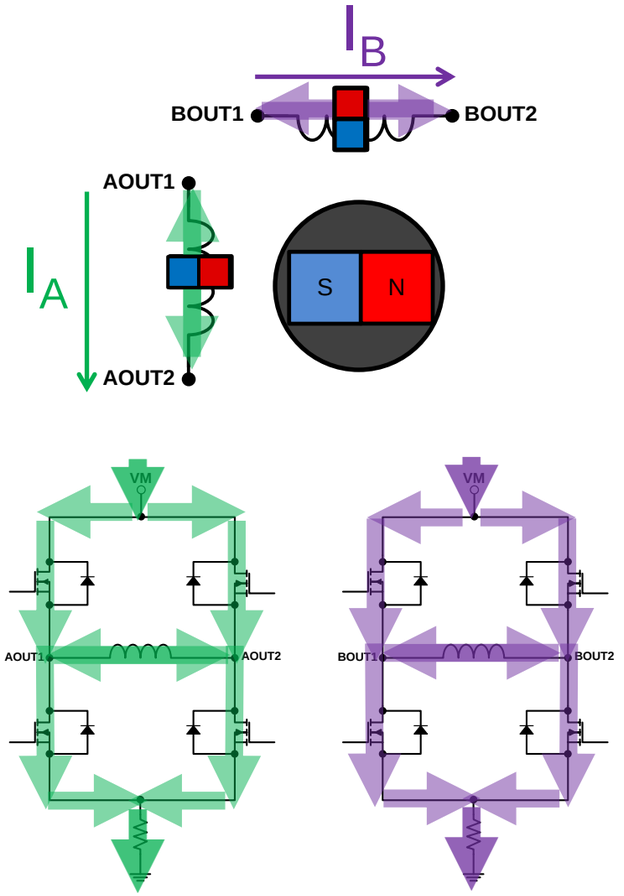
Half stepping – non-circular



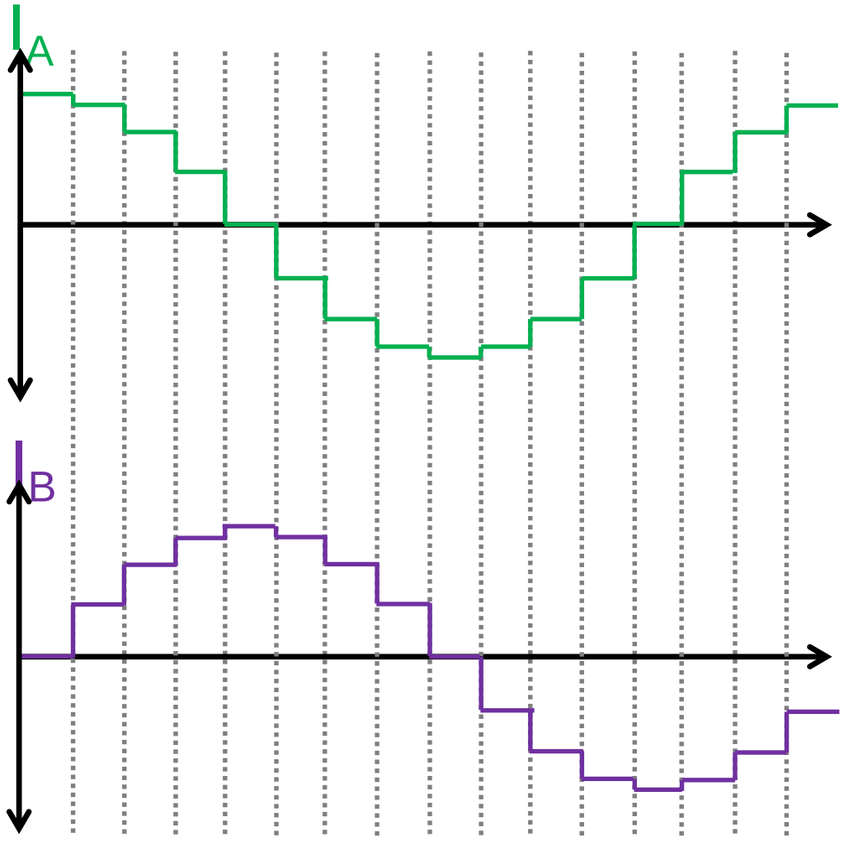


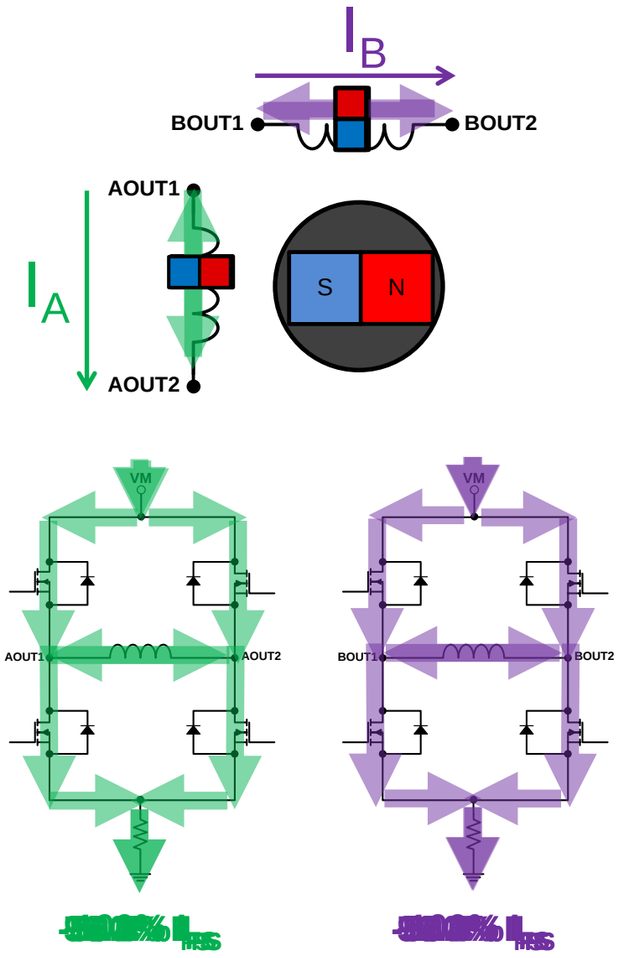
“Standard” half stepping – current regulation required





Microstepping – current regulation required





Microstepping performance

<table>
<tr><th>Full Step</th><th colspan="2">Half Step</th></tr>
<tr><td></td><td>Non-circular</td><td>Standard</td></tr>
<tr><td rowspan="2">+ Simple (no current regulation needed) [1]
+ Highest incremental torque output [2]
- Large step oscillations [2]
- Noisy / high vibration [1]</td><td colspan="2">+ Better step resolution vs. full step
+ Lower step oscillations vs. full step</td></tr>
<tr><td>+ Simple (No current regulation needed)
- Uneven torque ripple</td><td>+ Reduced torque ripple
- Requires some “minimal” level of current control</td></tr>
</table>

Micro-stepping (1/4, 1/8, 1/16, 1/32, 1/64, 1/128, 1/256, etc)
+ Smoother & quieter motion (reduced step oscillation) [2]
+ High step resolution [2]
+ Helps with resonance issues [1]
- Reduced incremental torque (higher possibility for misstep) [2]
- Requires sophisticated current regulation / control [1] ⟵ Typically integrated in stepper driver ICs

To find more stepper driver technical resources and search products, visit http://www.ti.com/motor-drivers/stepper-driver/overview.html

Resources

- [1] Acarnley, Paul P. *Stepping motors: a guide to theory and practice.* 4th ed., Institution of Engineering and Technology, 2007.
- [2] "Basics of Stepper Motors," *Technology*, *Stepper Motors*, orientalmotor.com.