

# Ampère's Law: Magnetic Field Inside a Long Solenoid



Apply Ampère's law,  $\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I_C$ , to the rectangular Amperian loop shown.

- Magnetic field inside: strong, uniform, directed along axis.
- Magnetic field outside: negligibly weak.
- Number of turns per unit length:  $n$ .
- Total current through Amperian loop:  $I_C = nIa$  ( $I$  is the current in the wire).
- Ampère's law applied to rectangular loop:  $Ba = \mu_0 nIa$ .
- Magnetic field inside:  $B = \mu_0 nI$ .

