

Introduction to AMR sensors

TI Precision Labs – Magnetic position sensing

Presented and prepared by Scott Bryson



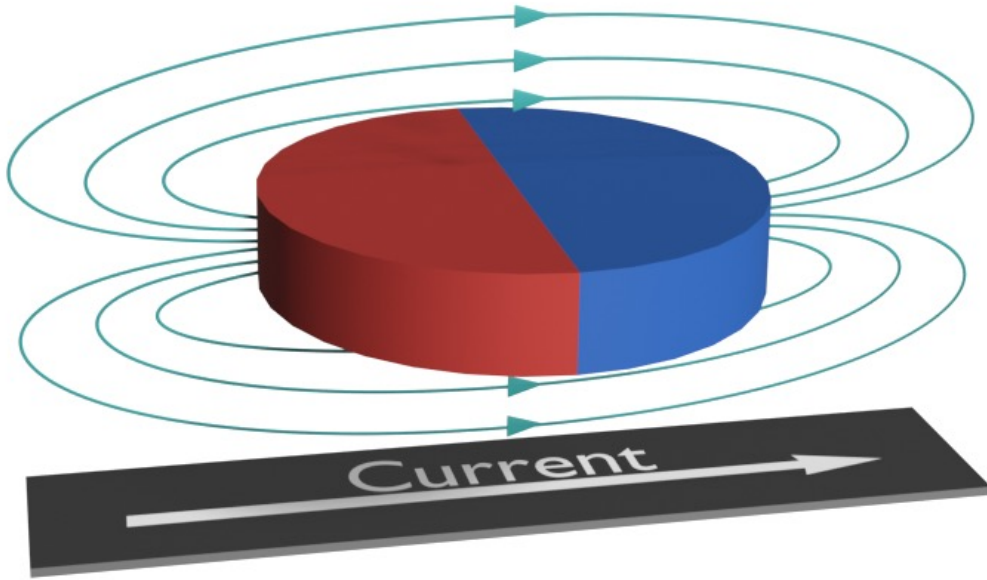
What is an AMR sensor?

Anisotropic magnetoresistance (AMR)

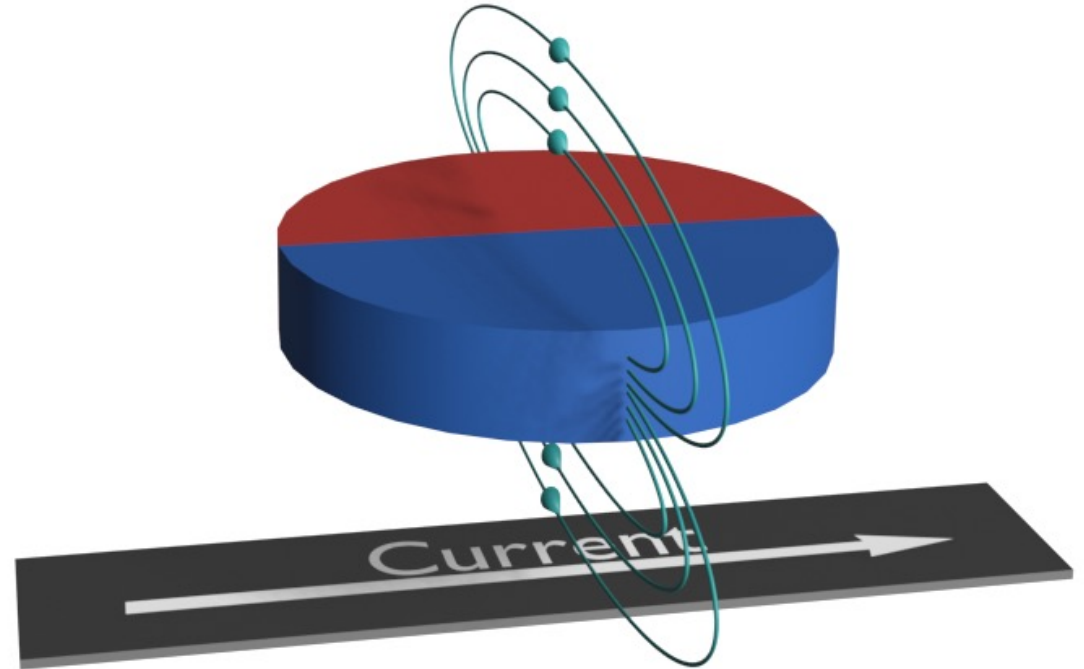
- Anisotropic implies changing resistance when measuring fields applied in different directions
- AMR sensors offer lower noise and higher sensitivity than Hall-effect sensors
- Better SNR allows for short sampling times for lower system latency

What is an AMR sensor?

Anisotropic magnetoresistance (AMR)

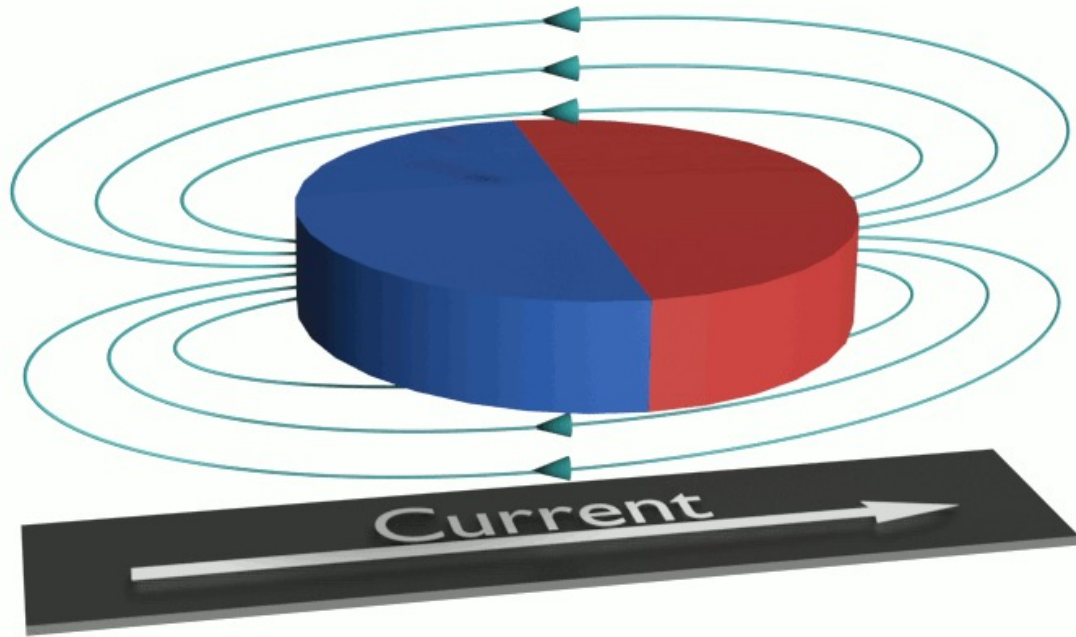


Parallel current

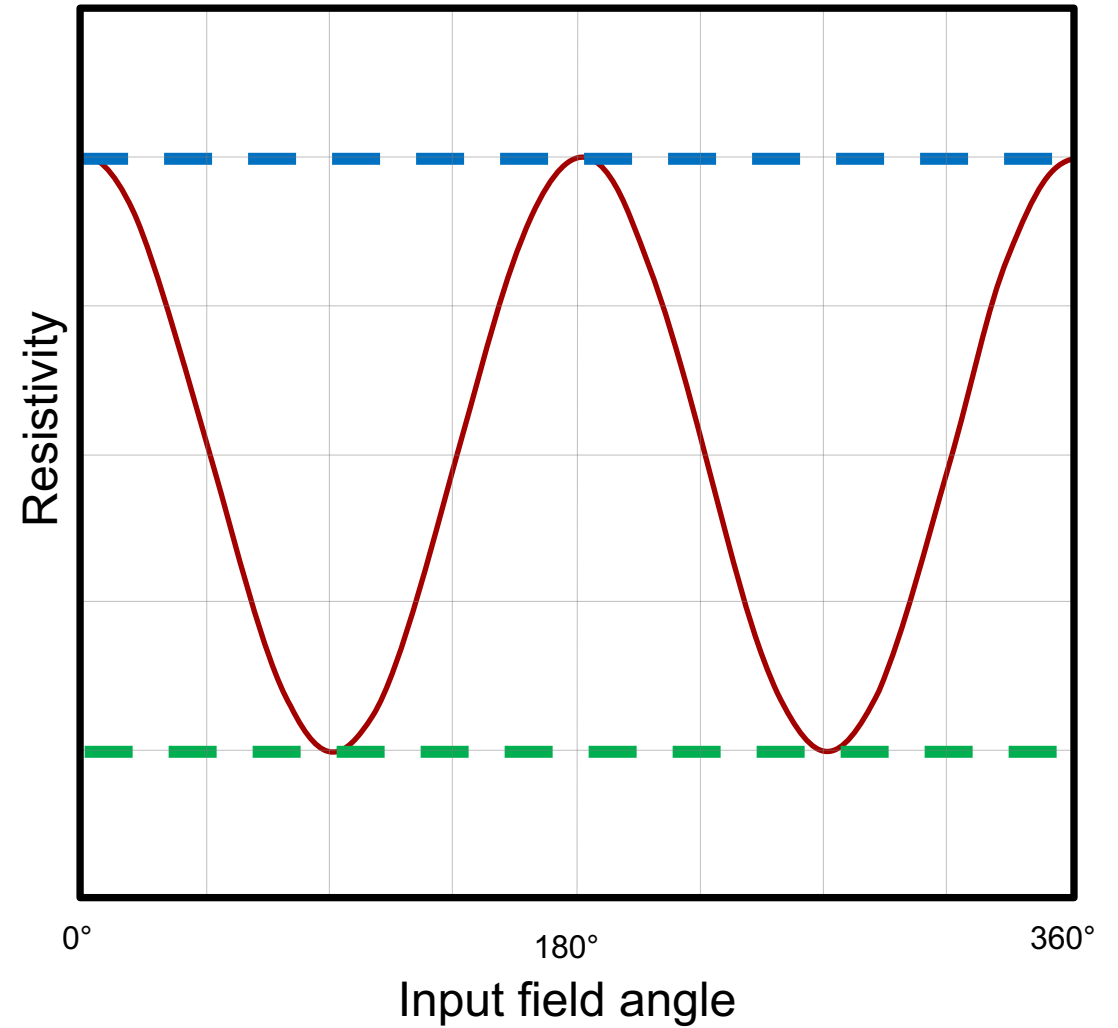


Perpendicular current

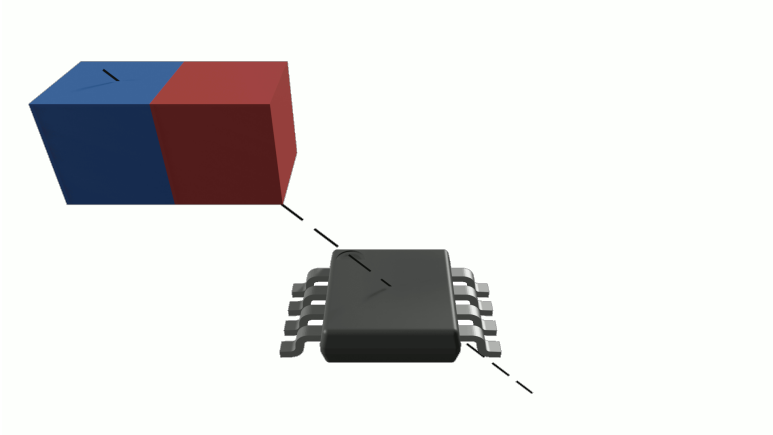
Changing resistivity



$$\rho_{\theta} = \rho_{\parallel} + \rho_{\perp} \times \frac{1 - \cos(2\theta)}{2}$$



Sensing applications

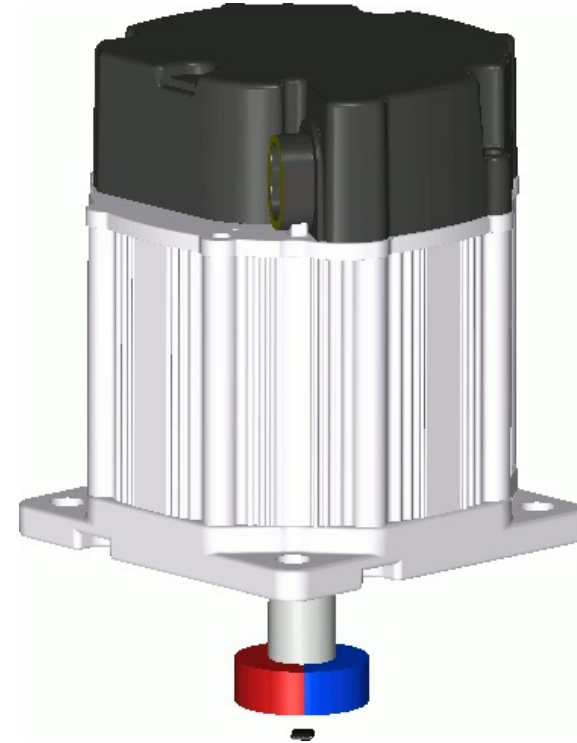


Low-power switch

Sensing applications

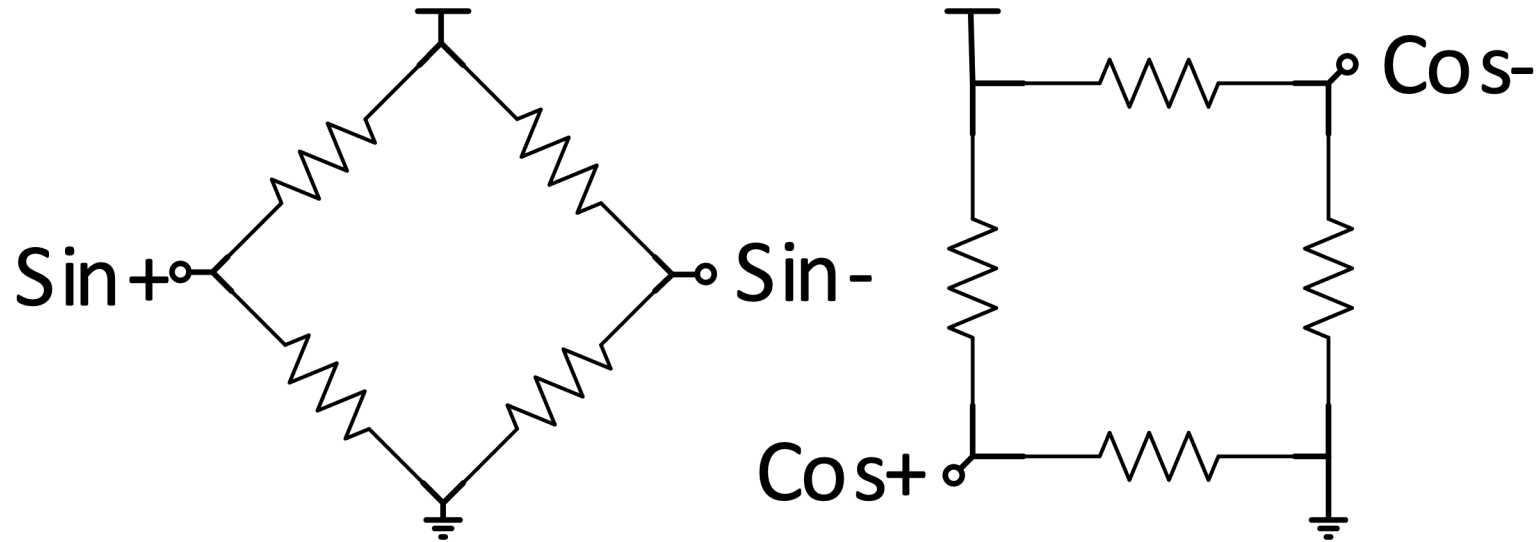


Low-power switch



Angle sensing

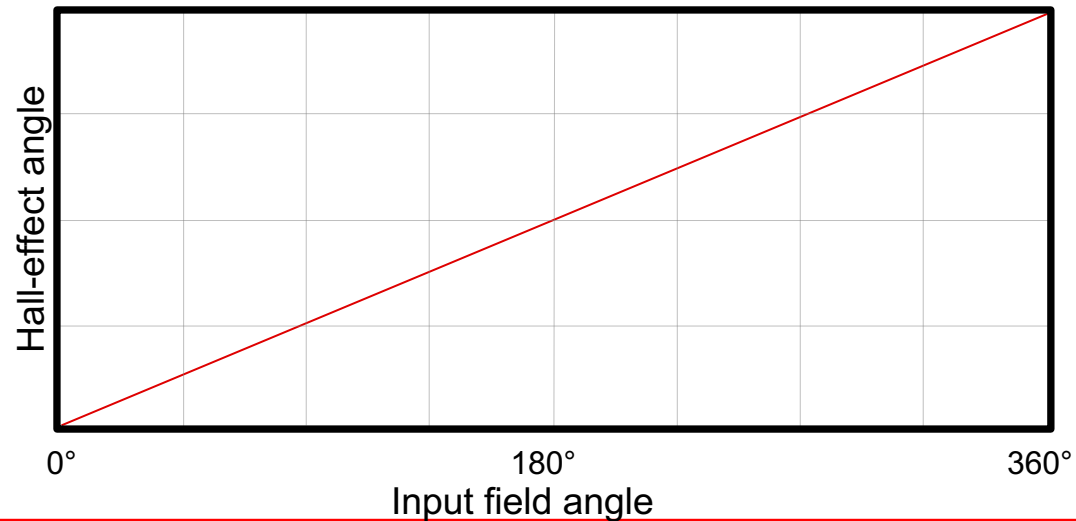
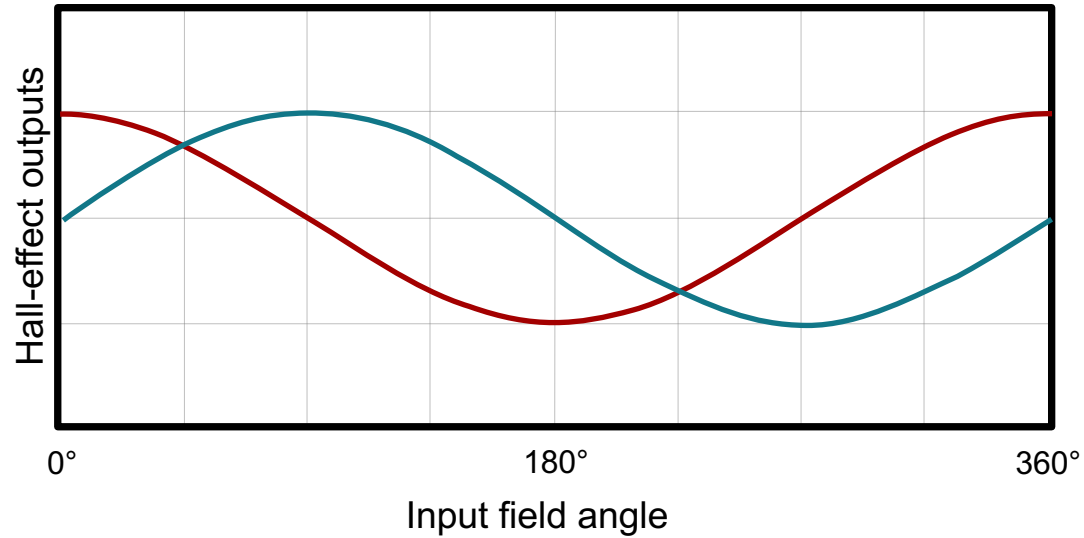
Angle sensing



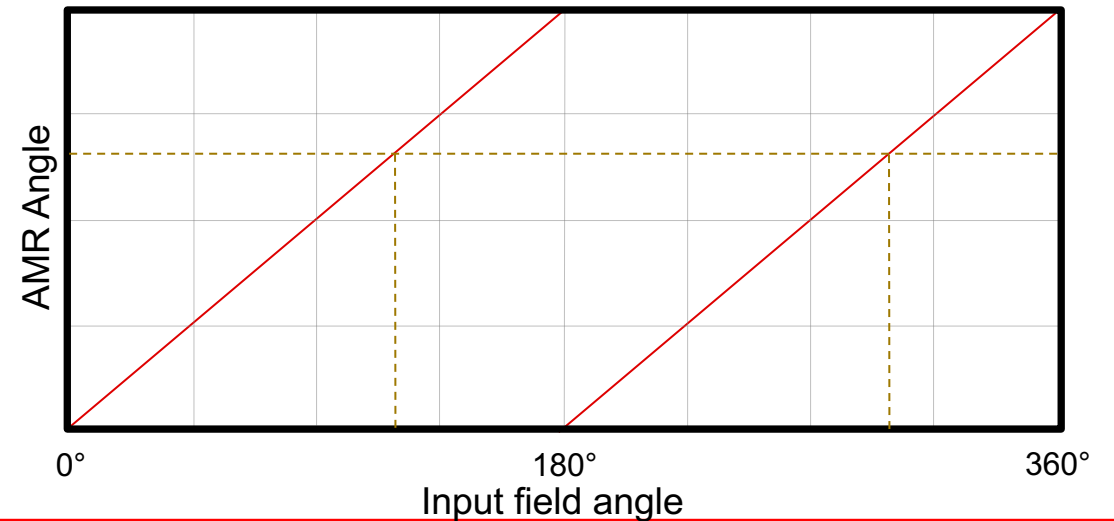
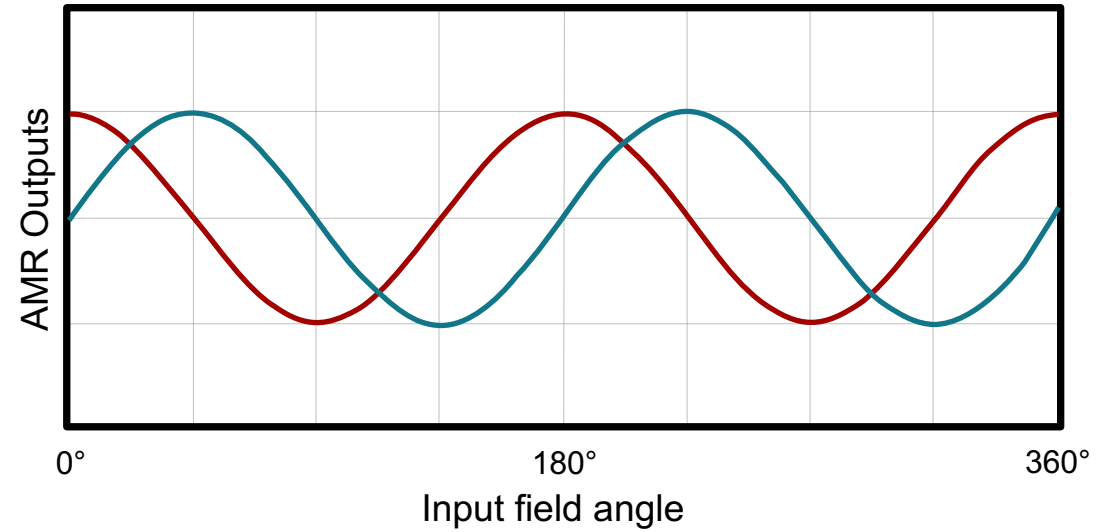
- Wheatstone bridge configurations are used to create differential sine and cosine.
- AMR offers lower-noise angle measurements than what is typically achieved using Hall-effect sensors.

Angle measurements

3D Hall-effect angle measurement

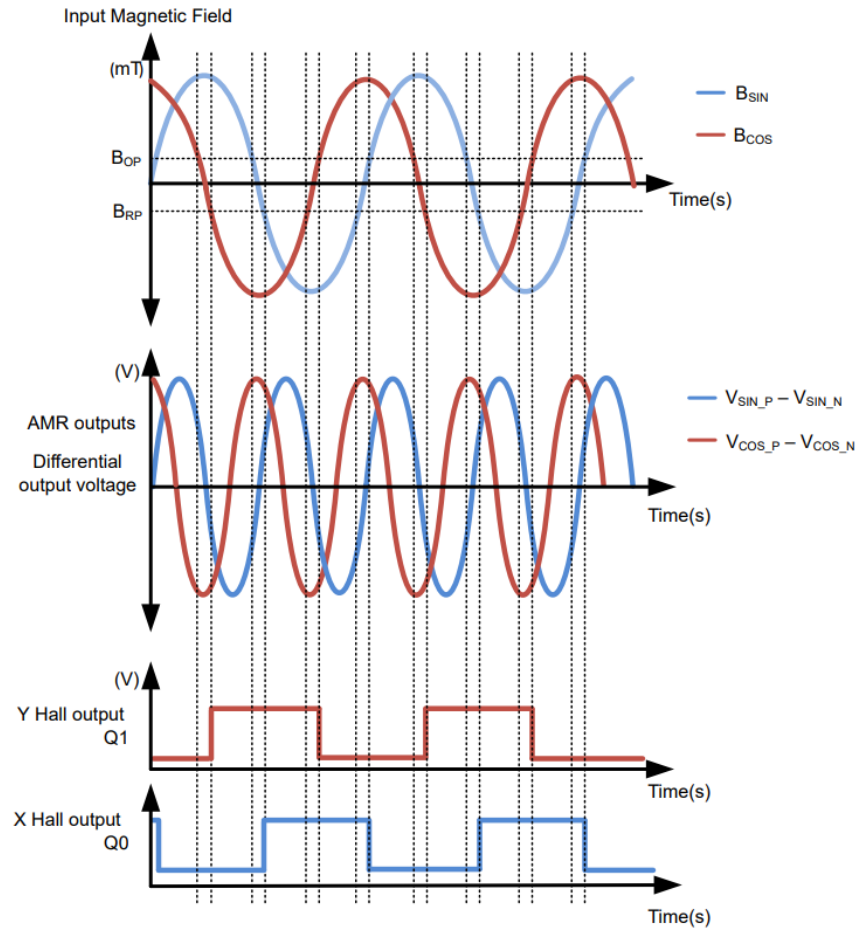


AMR angle measurement

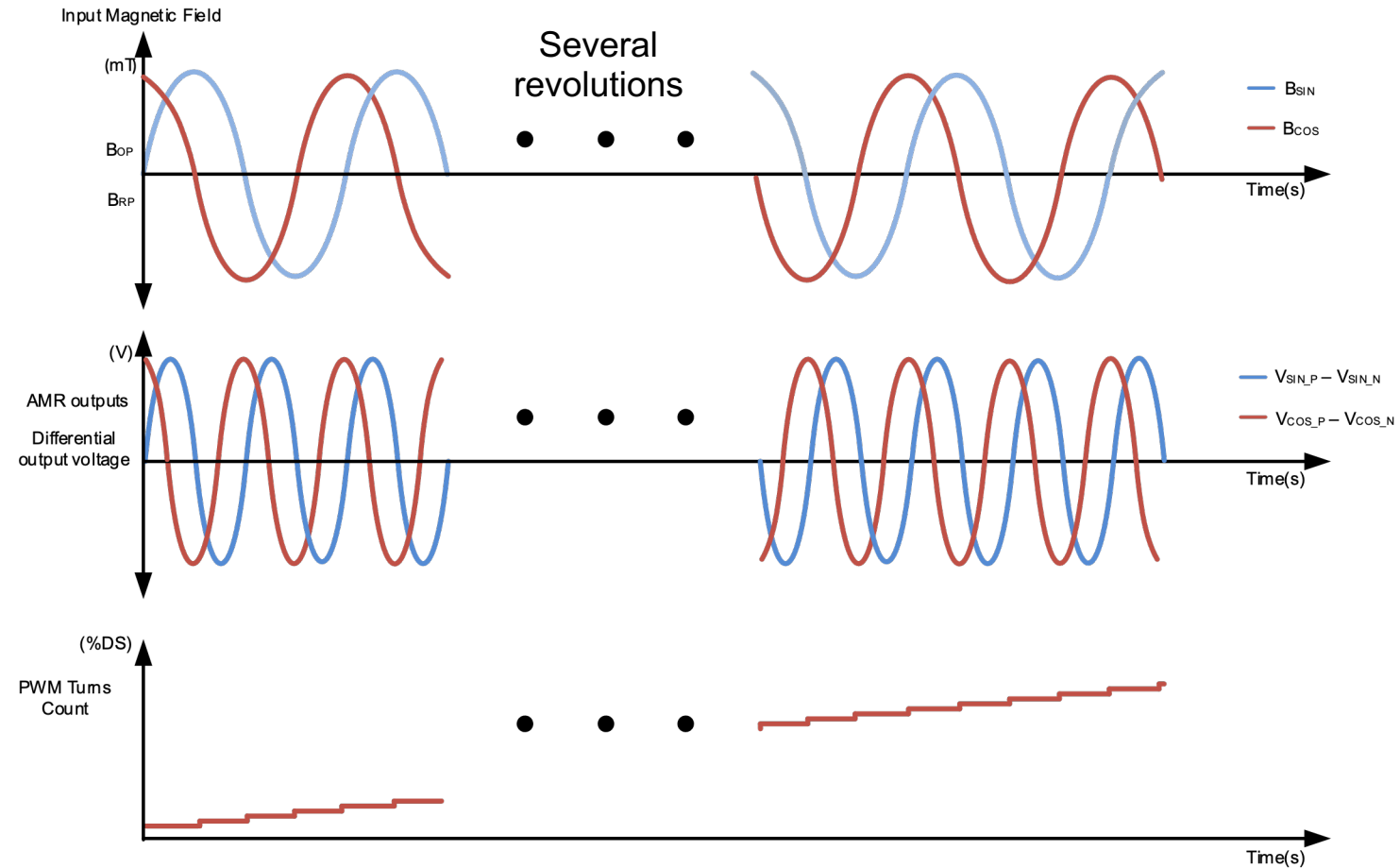


Resolving 360°

TMAG6180-Q1 output response



TMAG6181-Q1 output response



Additional learning

To learn more about AMR sensing using devices such as TMAG6180-Q1 and TMAG6181-Q1, click to download the documents:

- Calibration of AMR Angle Sensors: <https://www.ti.com/lit/slya085>
Discusses the output format common to these devices, what error sources may be present in the system and provides insight how to calibrate the sensor
- Benefit of Low-Power Turns Count in AMR Sensing: <https://www.ti.com/lit/slya084>
Discusses how the turns count feature benefits systems that require low-power angle monitoring
- Position Sensing in Automotive Door Handle Systems: <https://www.ti.com/lit/snoaa98>
Discusses the use case of TMAG6180-Q1 to monitor the position of deployable door handles to enable position feedback controls

To find more technical resources
and search products, visit
ti.com/AMR