EIPC
NEE-403
Unit-2
Hall effect TRANSDUCERS

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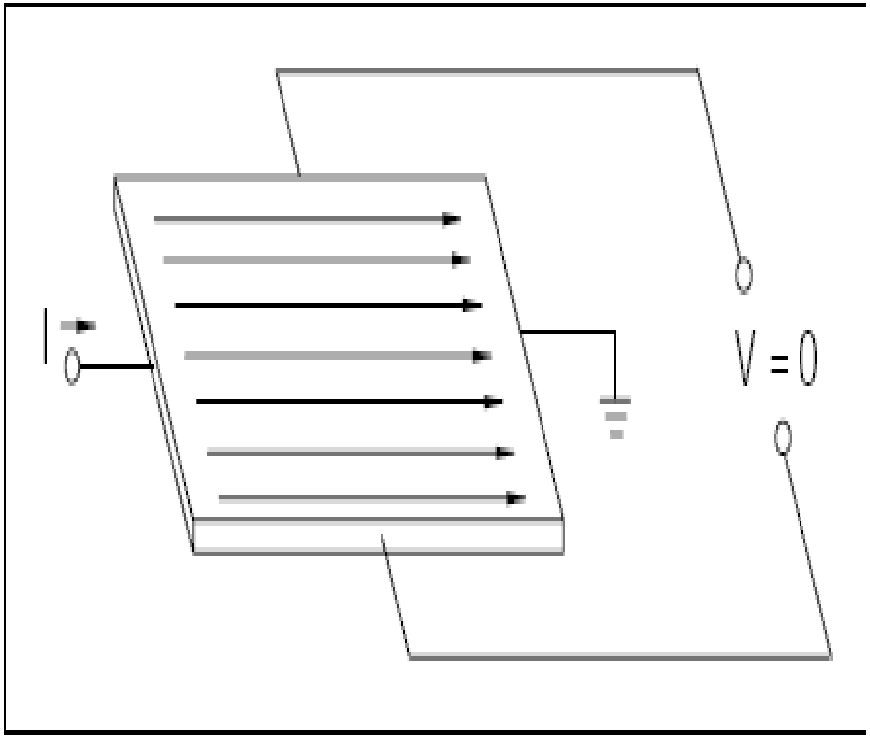
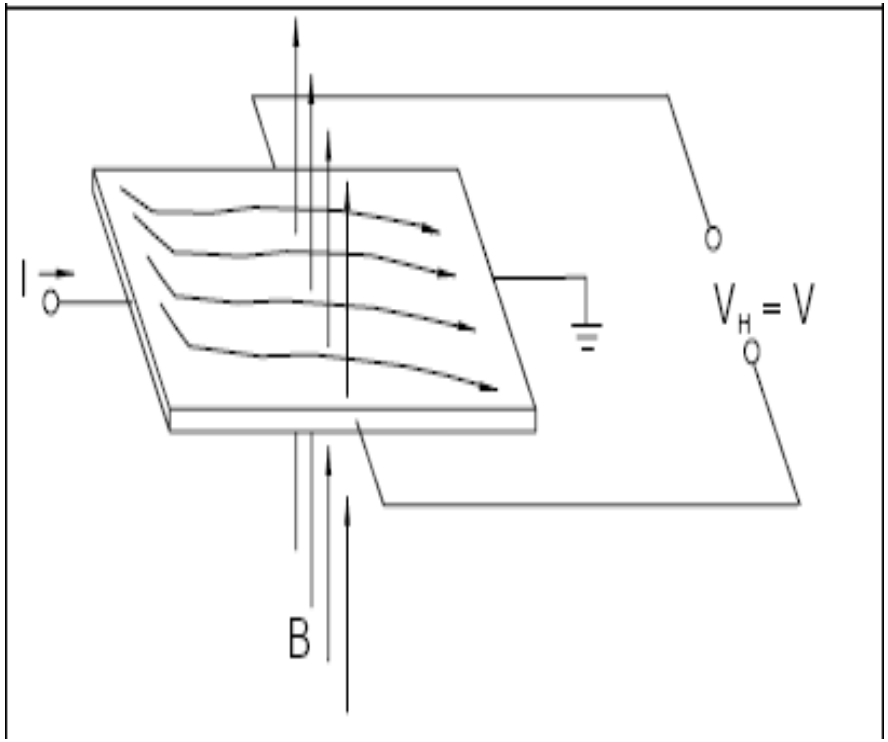
Theory of the “Hall Effect”

Hall effect principle, no magnetic field



Hall effect principle, magnetic field present



Potential Difference
(voltage) across output:

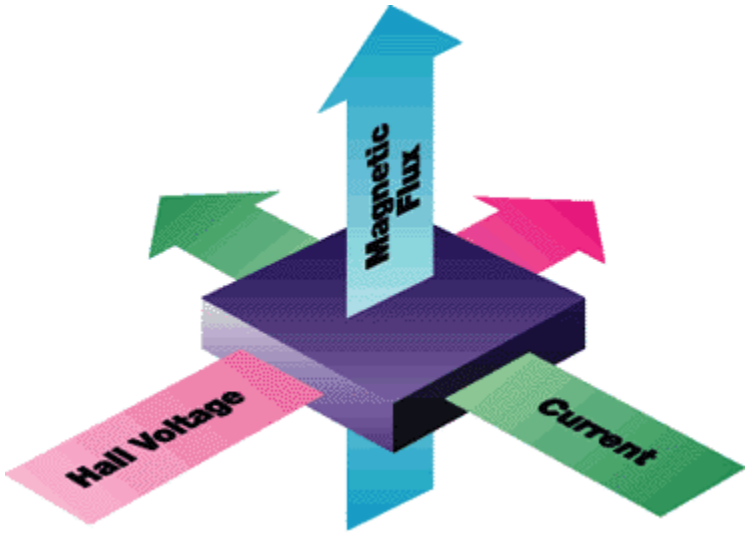
$$V = I * B$$

Introduction

- The function of the Hall Sensor is based on the principle of the Hall Effect.
- A Voltage is generated transversely to the current flow direction, if a magnetic field is applied perpendicularly to the conductor.

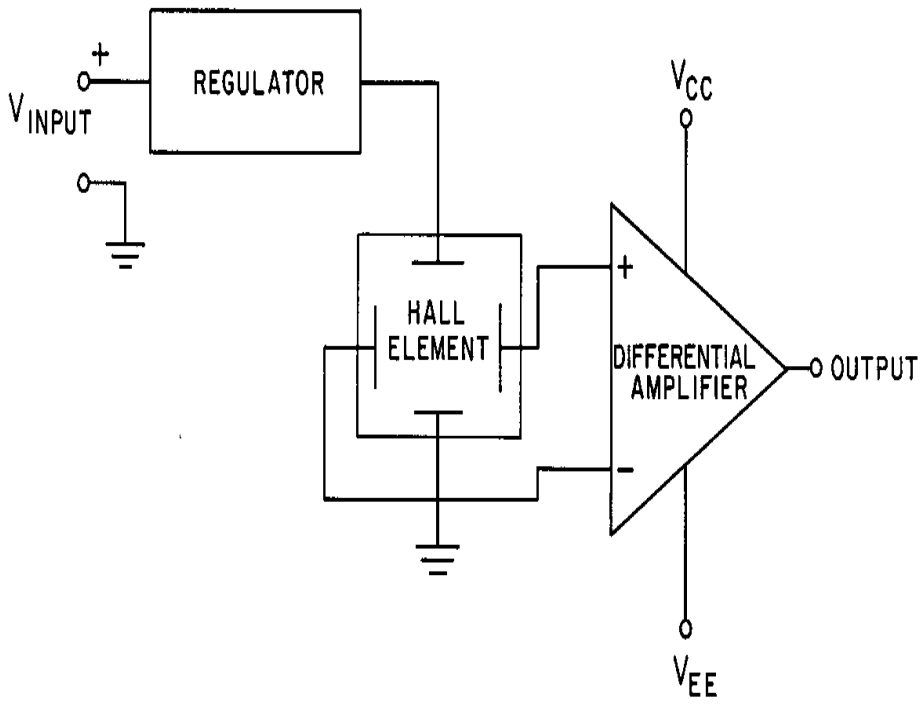
Principle

- In the Semiconductor a voltage is created that is the effect of a magnetic field operating perpendicularly to the current.



Basic Hall Effect Sensor

- **Hall element** is the basic magnetic field sensor
- **Differential Amplifier** amplifies the potential difference (Hall voltage)
- **Regulator** holds current value so that the output of the sensor only reflects the intensity of the magnetic field

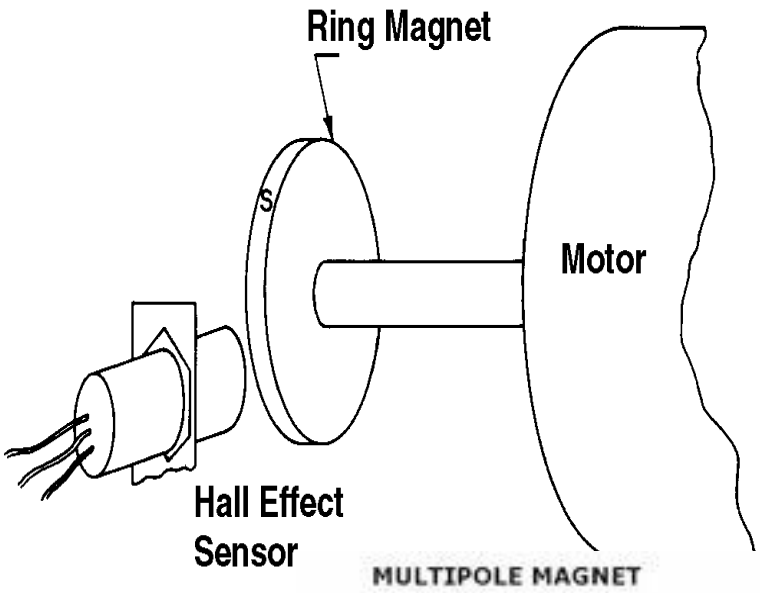


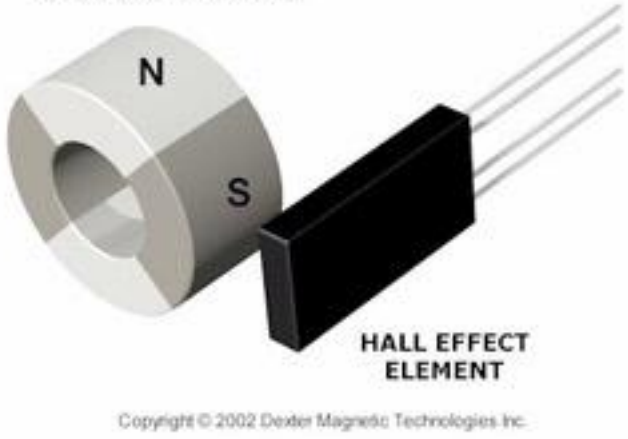
Hall Effect Sensor Example

SPECIFICATIONS			Digital Switch c
Hall Type			3 Wire (Voltage output)
Supply Voltage (Note 1)	Absolute Ratings	Vdc	-15 to +28
	Operate	Vdc	+3.8 to +24
	Overvoltage Protection	Vdc-max	32
Output High Voltage		Vdc	sinking output
Output Low Voltage		Vdc-max	0.4 @ 10mA
Output Current (continuously on)		mA-max	10
Current Consumption over Temperature Range	Low	mA	1.6 - 5.2
	High	mA	1.6 - 5.2
Switching Speed		kHz-max	10
Temperature	Operating	°C	-40 to +100
	Storage	°C	-65 to +105

Application: Response to South or North Polarity

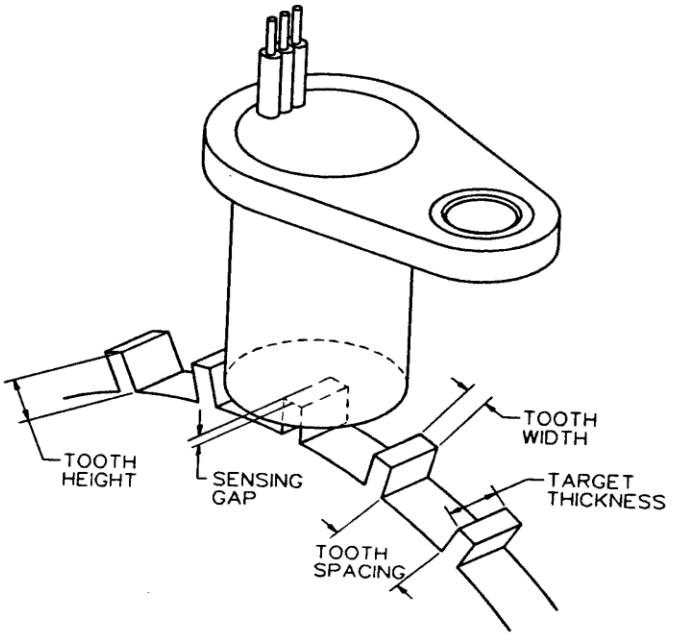
- Motor-Tachometer application where each rotation of the motor shaft is to be detected
- When ring magnet rotates w/ motor, South Pole passes the sensing face of the Hall sensor after each revolution.
- Sensor
  - Actuated when the South Pole approaches sensor
  - Deactuated when South Pole moves away from sensor
- Single digital pulse produced for each revolution.

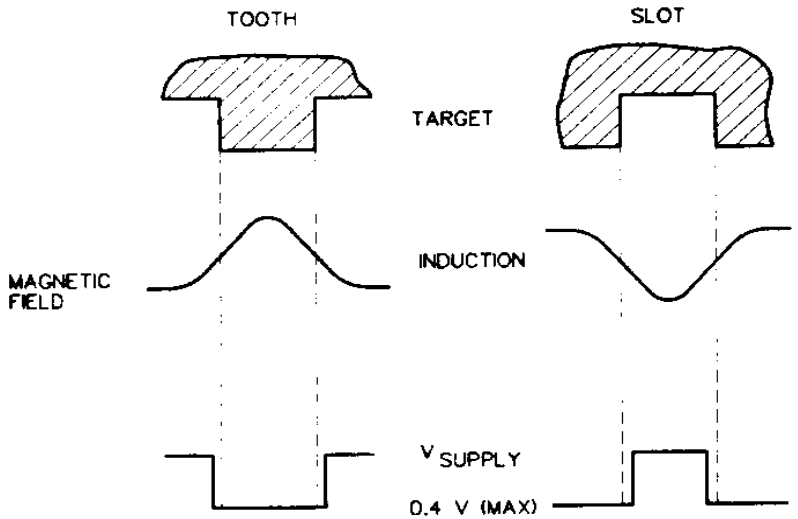




Application: Gear Tooth Sensing

- Sense movement of ferrous metal targets (magnetically biased)





- Sensor detects change in flux level
- Translates it into a change in the sensor output (high to low)

Applications
(To Name a Few)

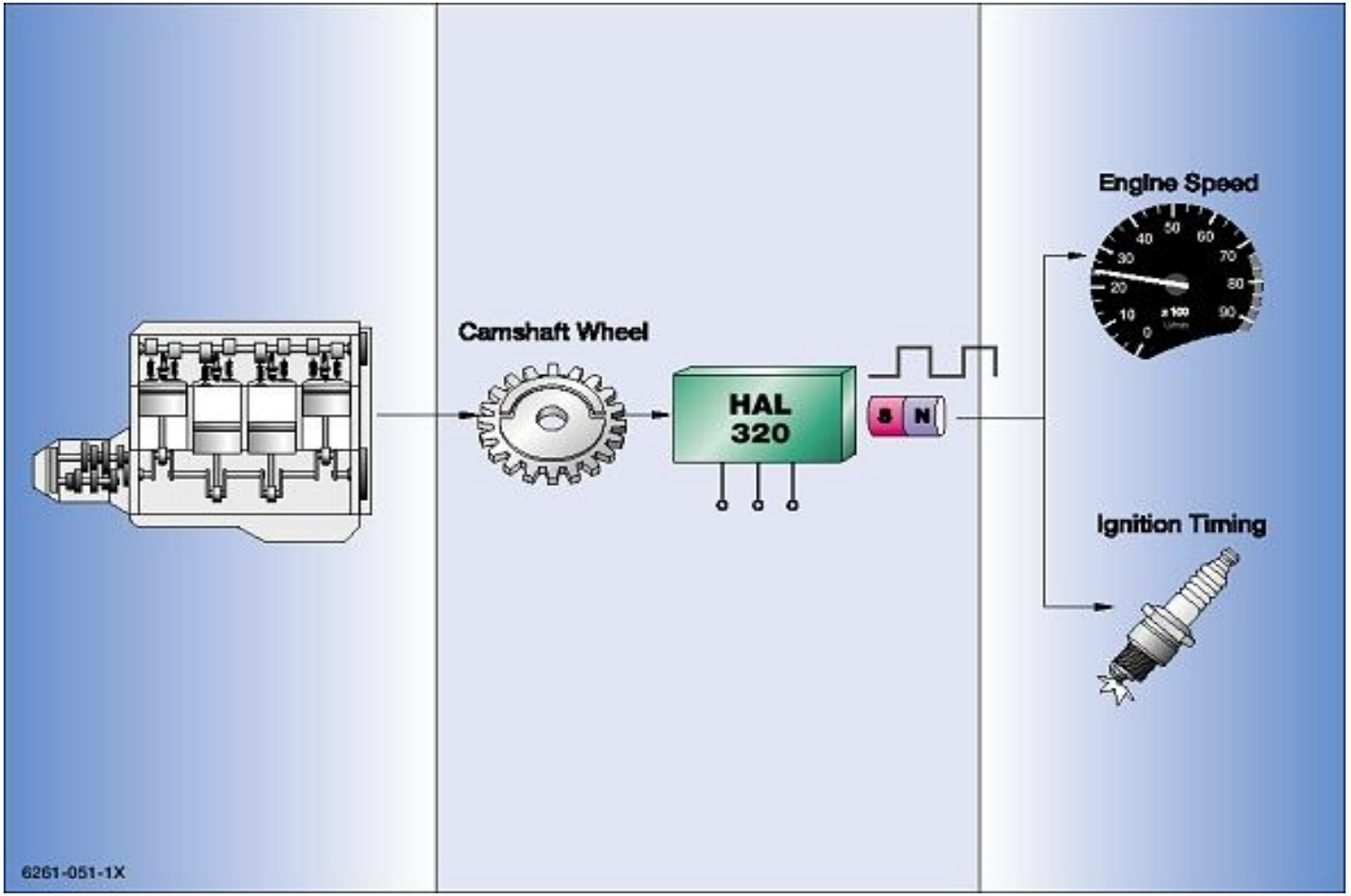
- Automotive Applications
- camshaft sensor
- crankshaft
- sensor ignition
- timing engine speed
- drive-by-wire
- brake-by-wire
- steer-by-wire
- throttle position sensor
- current measurement

- Industrial Applications
- commutation of brushless DC motors
- cooling fans
- RPM measurement
- wheel speed sensors
- angle sensor
- current measurement
- position measurement
- distance measurement

Typical Application – RPM Measurement

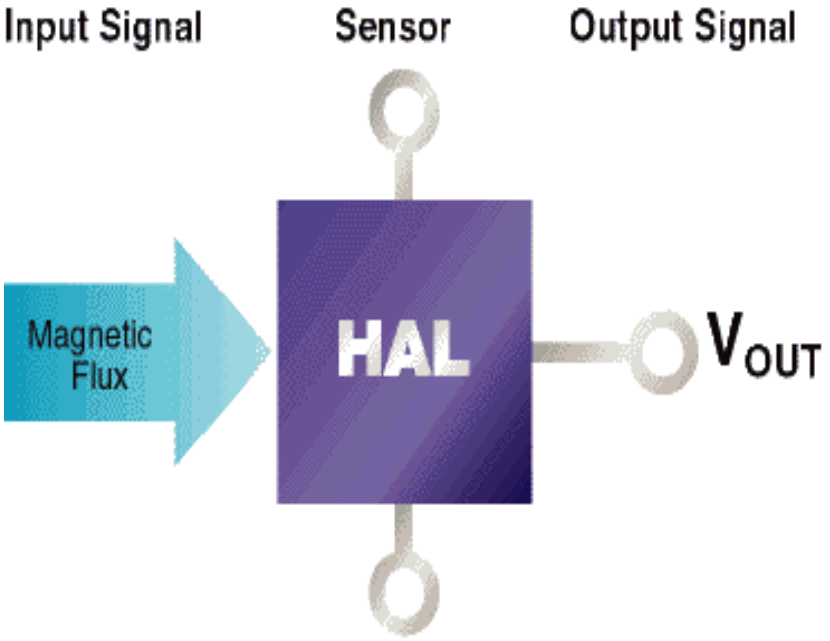
- By placing a Hall Sensor on the Camshaft Wheel.
- The rotating wheel modulates the field and the teeth of the wheel are detected
- The control signals can now be sent for computer control or motor management

Typical Application – RPM Measurement



Functional Principle

- Functional principle of a Hall sensor: The output voltage of the sensor and the switching state, respectively, depend on the magnetic flux density through the Hall plate.



Limitations

- High Sensitivity = High Cost
- Must create strong mounting HW
- Often need digital control though it is an analog sensor
- Operation Range
- Frequency Response
- Mechanical Voltage Offsets

Advantages

- Non-Intrusive – You don’t need to cut into mechanics very often
- Cheaper than Current Transformers
- Zero insertion loss
- > 95% accuracy

Conclusions

- Hall sensors are ideal for non-intrusive sensing of rotational position and location detection
- Signal is used for analog and digital detection

Thank You