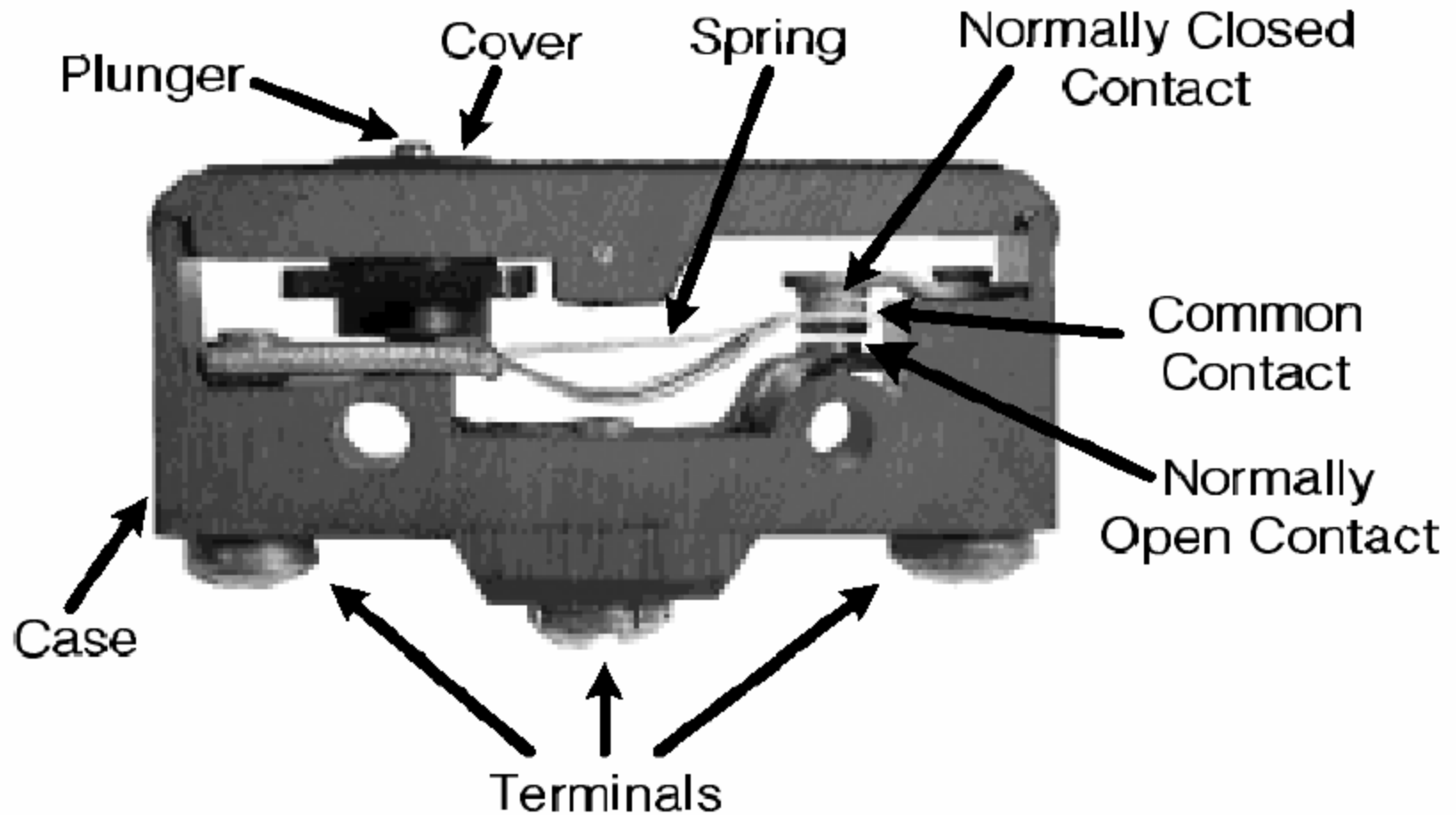


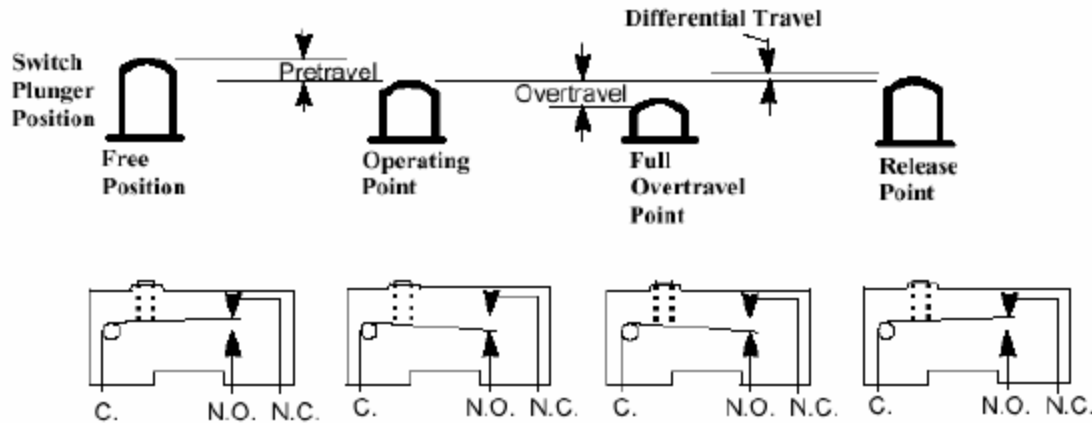
Position Sensing

- Mechanical
- Optical
- Magnetic

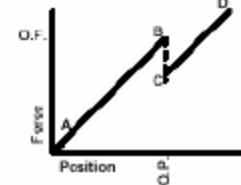
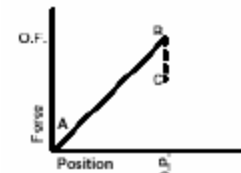
Mechanical Sensing - Microswitch



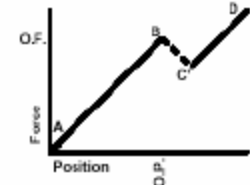
Microswitch Operation



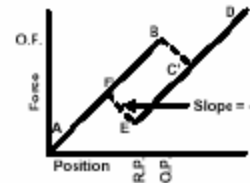
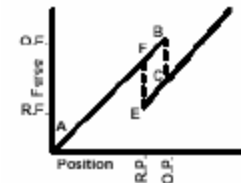
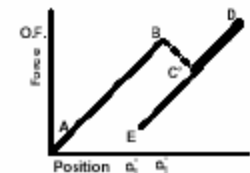
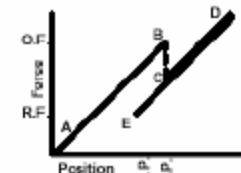
With Rigid Actuating Device



With Resilient Actuating Device Having Spring Rate K



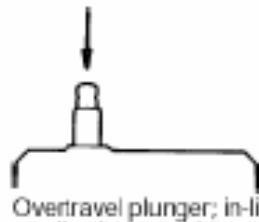
Switch exhibits mechanical hysteresis.



Microswitch Actuators



Pin plunger; in-line motion



Overtravel plunger; in-line applications requiring additional overtravel



Added overtravel in a panel mount roller plunger; Actuation by cams



Leaf; Low-force, slow moving cams or slides



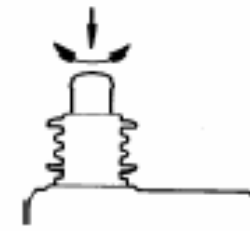
Roller lever; Very low force, fast moving cams



Roller leaf; Low-force, large movement actuation



Lever; Very low force, slow cams and slides



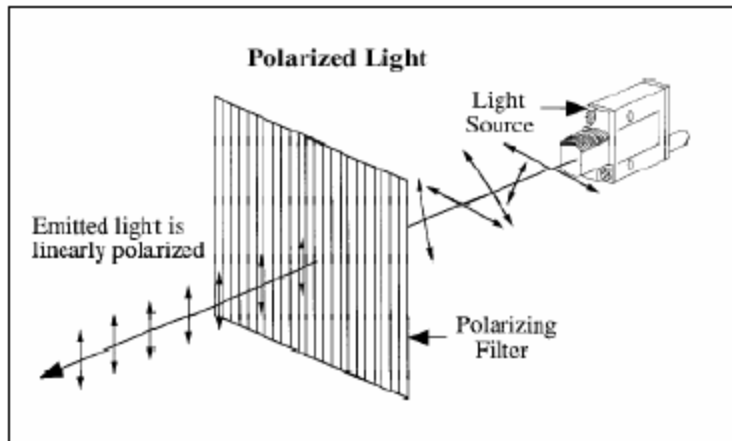
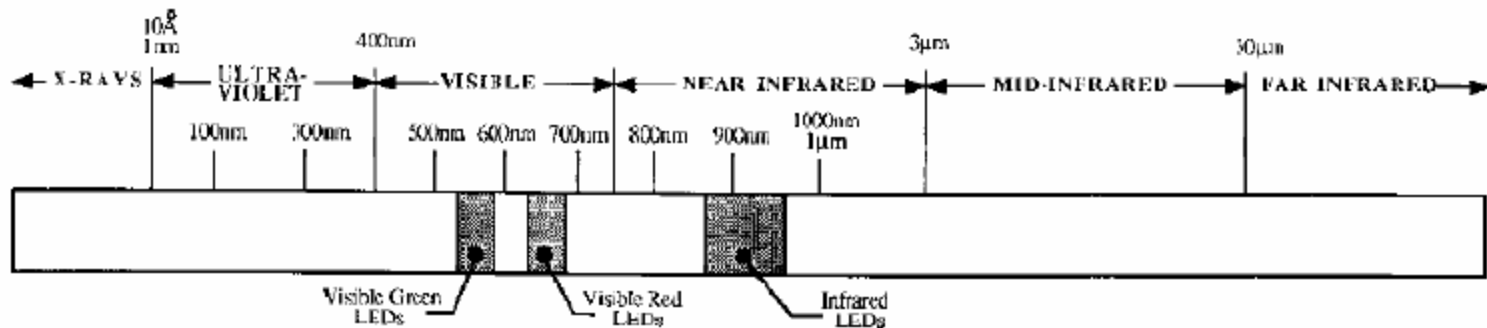
Added overtravel in a panel-mount plunger; Heavy-duty in-line applications or slow cams. Cam rise should not exceed 30°

Optical Sensing

- LED's and Photodiodes
- Transmissive/Reflective
- Modulated/Unmodulated
- Light-on/Dark-on
- Fiber optic

LED and Photodiode Characteristics

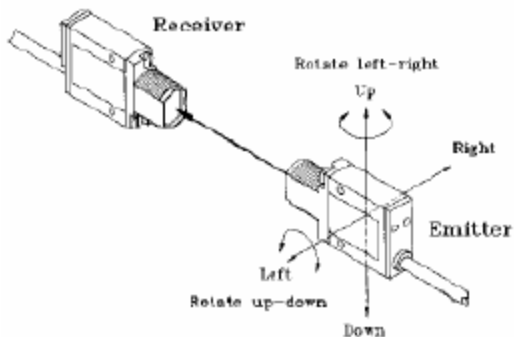
Wavelengths of Commonly-used Light Emitting Diodes (LEDs)



Transmissive & Reflective Sensors

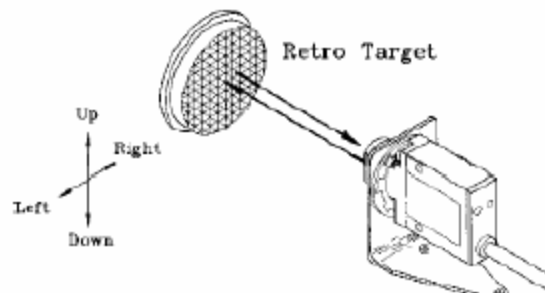
Opposed Mode Alignment

Opposed Mode Alignment: Move Emitter or Receiver Up-Down, Left-Right, and Rotate



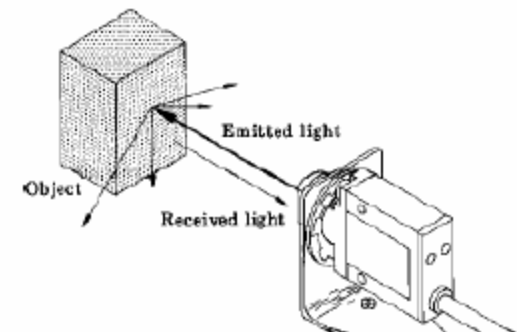
Retroreflective Mode Alignment

Retroreflective Mode Alignment: Move Target Up-Down, Left-Right

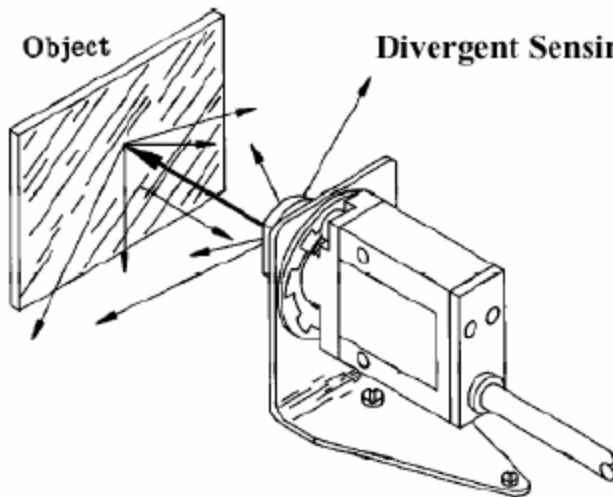


Proximity (Diffuse) Mode Alignment

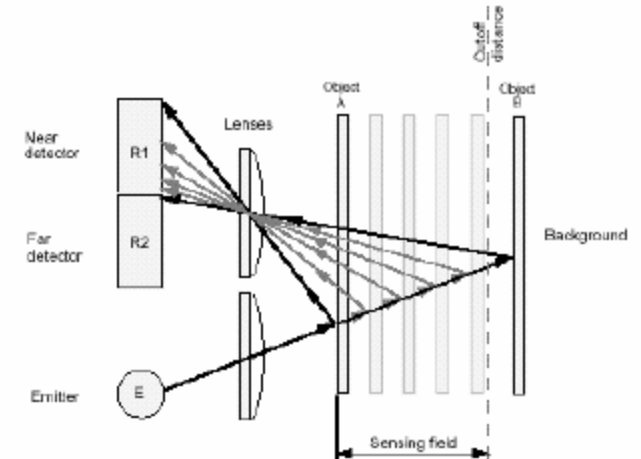
Diffuse Mode Alignment: Rotate Up-Down, Left-Right



Object Divergent Sensing Mode



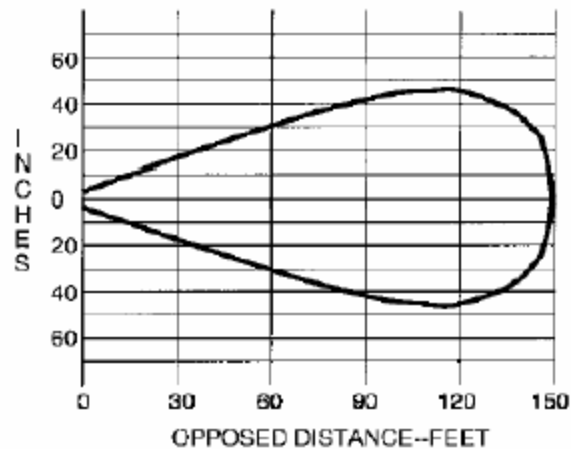
Fixed-field Diffuse Sensing



Object is sensed if amount of light at R1 is greater than the amount of light at R2

Beam Pattern and Reflectance

Typical Beam Pattern

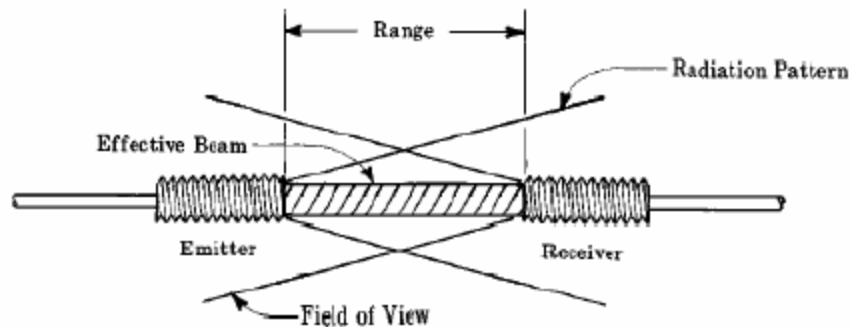


RELATIVE REFLECTIVITY TABLE

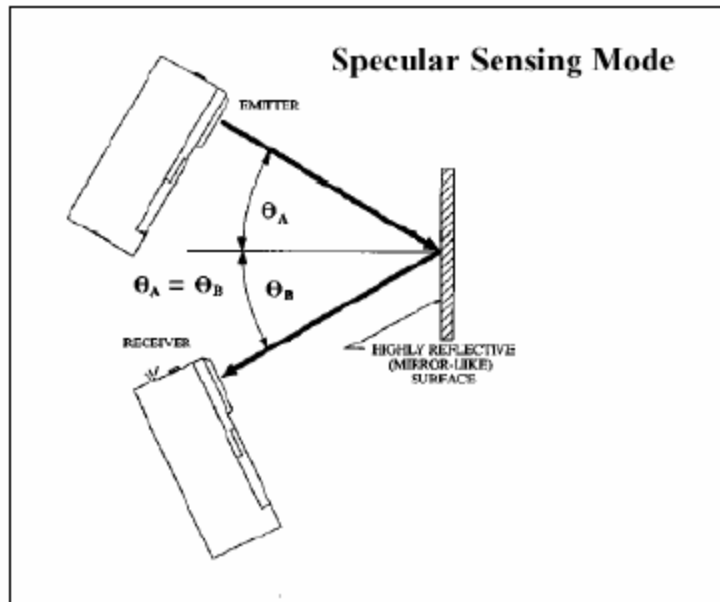
Material	Reflectivity (%)	Excess Gain Required
Kodak white test card	90%	1
White paper	80%	1.1
Masking tape	75%	1.2
Beer foam	70%	1.3
Clear Plastic*	40%	2.3
Rough wood pallet (clean)	20%	4.5
Black neoprene	4%	22.5
Natural aluminum, unfinished*	140%	0.6
Stainless steel, microfinish	400%	0.2
Black anodized aluminum*	50%	1.8

*NOTE: For materials with shiny or glossy surfaces, the reflectivity figure represents the maximum light return, with the sensor beam exactly perpendicular to the material surface

Effective Beam



Specular Reflection



Modulation

- “Chop” LED on and off at many kHz rate
- Bandpass filter after photodiode at the same frequency as chopping
- Threshold circuit after BPF generates on/off output

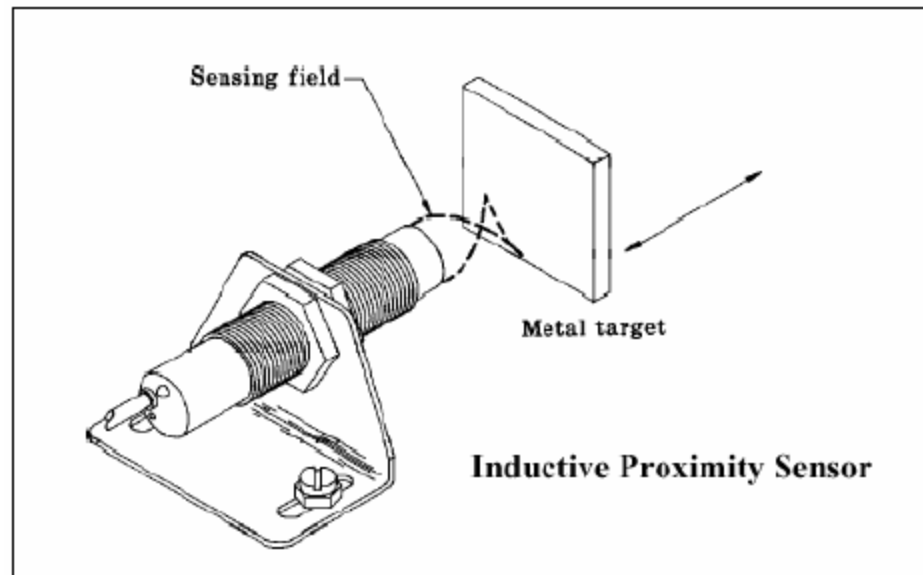
Magnetic Position Sensors

- Reed switches (sense permanent magnet)
- Inductive proximity sensors (eddy current)
- Hall Sensors (sense permanent magnet)

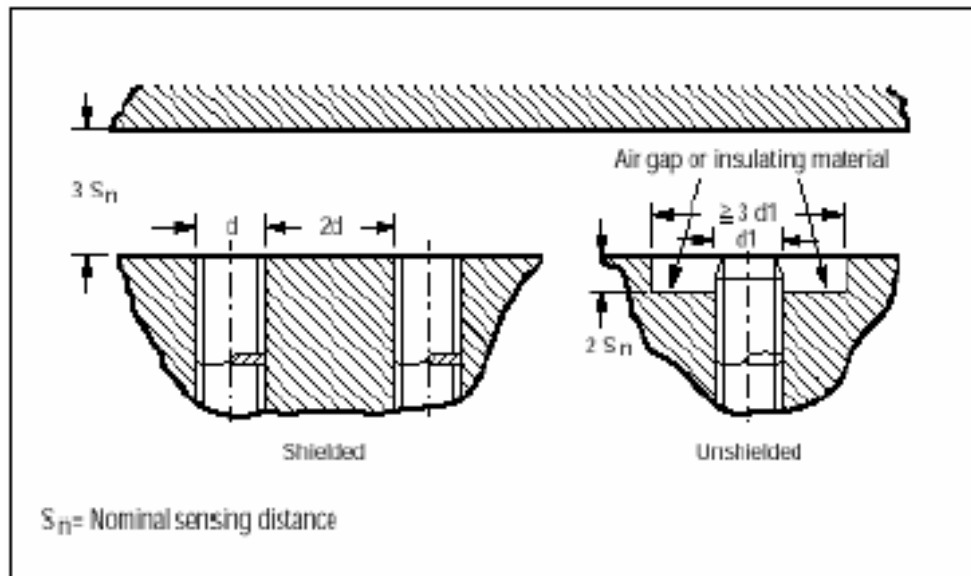
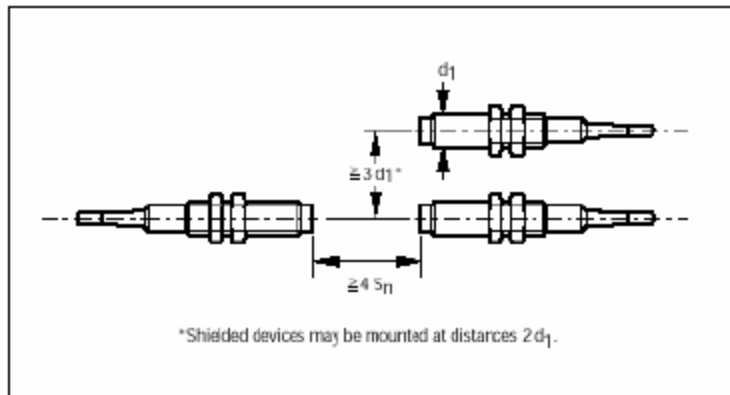
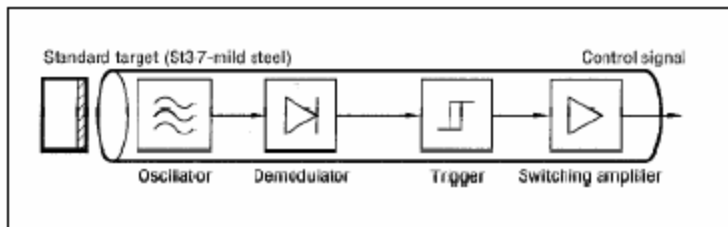
Other Discrete Position Sensors

- capacitive
- ultrasonic
- variable reluctance (coil around magnet, senses moving ferrous material)

Inductive Proximity Sensor

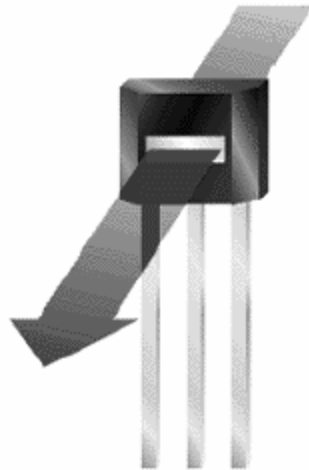
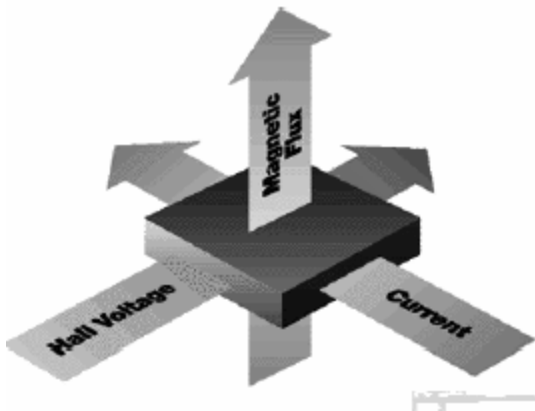


Inductive Proximity Sensors

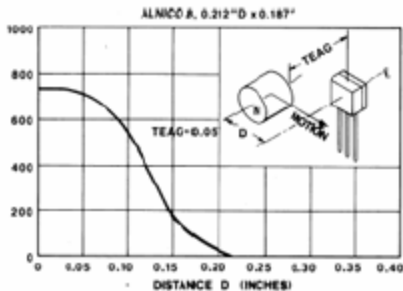
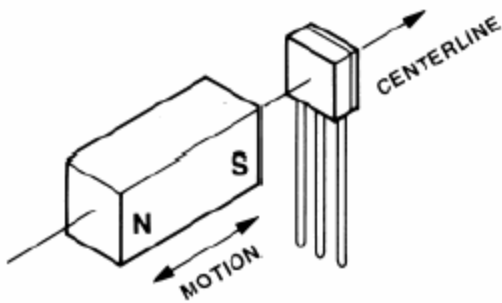


Hall Sensors

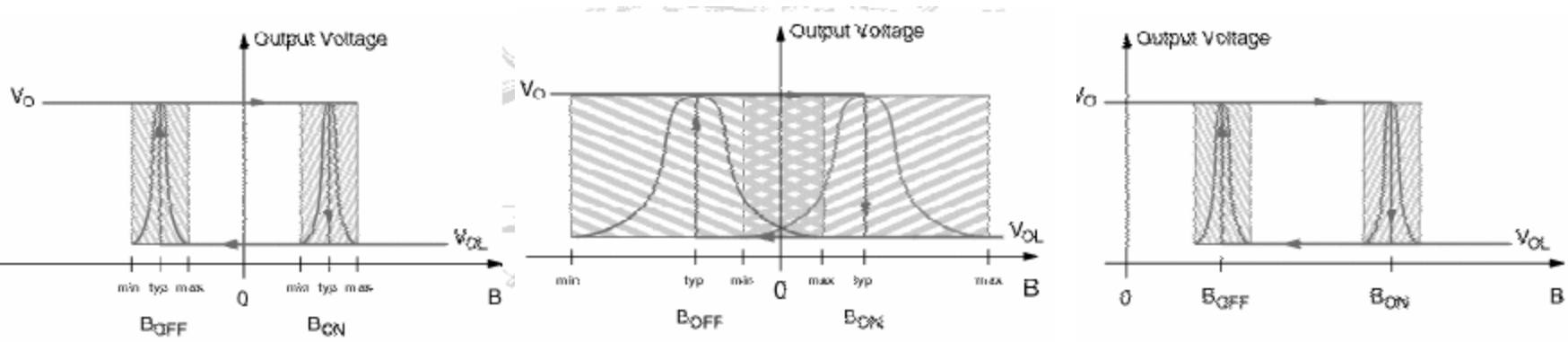
- Hall effect:
 - constant voltage forces a constant current in semiconductor sheet
 - magnetic field flux lines perpendicular to current cause proportional voltage across sheet.
 - discovered by E.F.Hall in 1879
- Linear sensor needs voltage regulator and amplifier
- Switch also needs threshold circuit, with hysteresis



Hal I Switch



- Magnet motion
 - head-on
 - bypass or slide-by
- Total effective air gap (TEAG)
- Sensitivity, Hysteresis, & Temperature



Other Discrete Position Sensors

- capacitive
- ultrasonic
- variable reluctance (coil around magnet, senses moving ferrous material)