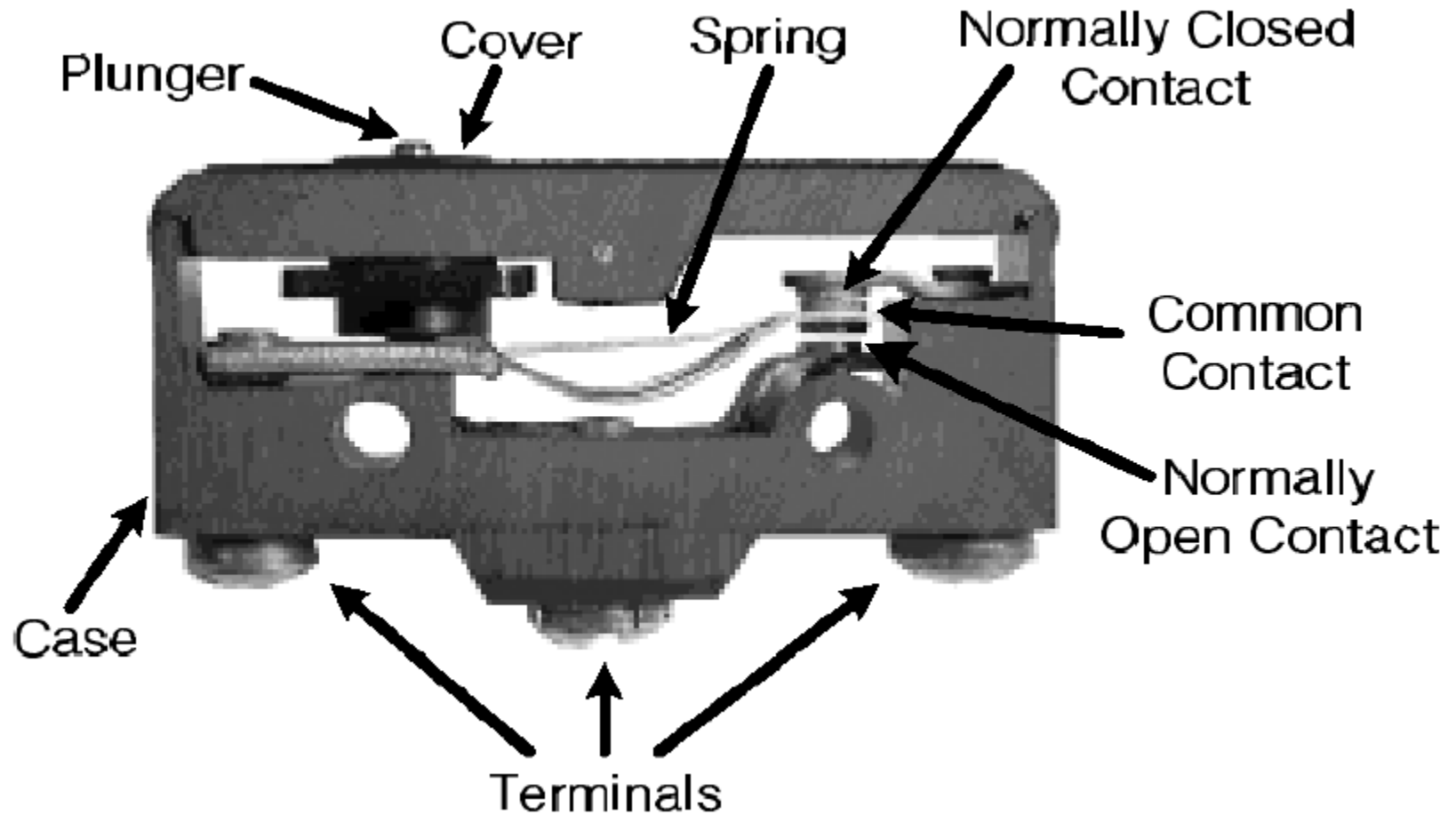


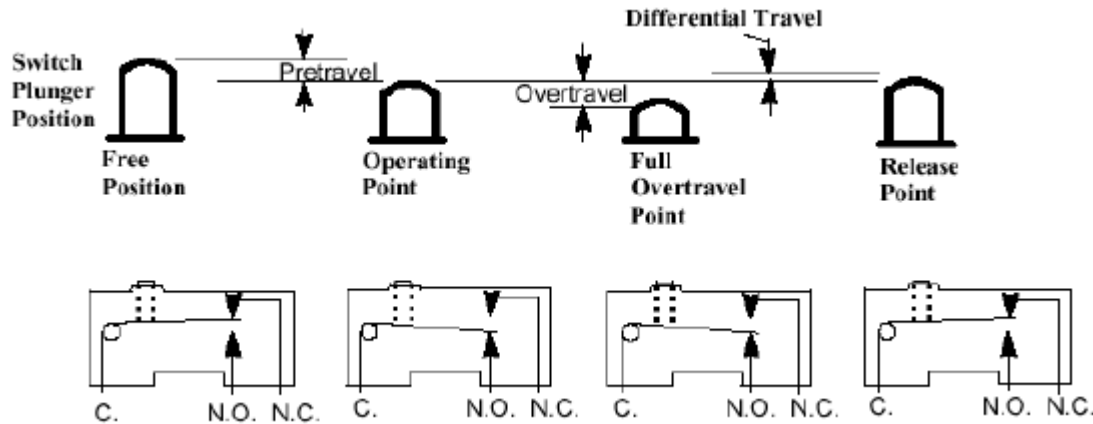
POSITION SENSING

- Mechanical
- Optical
- Magnetic

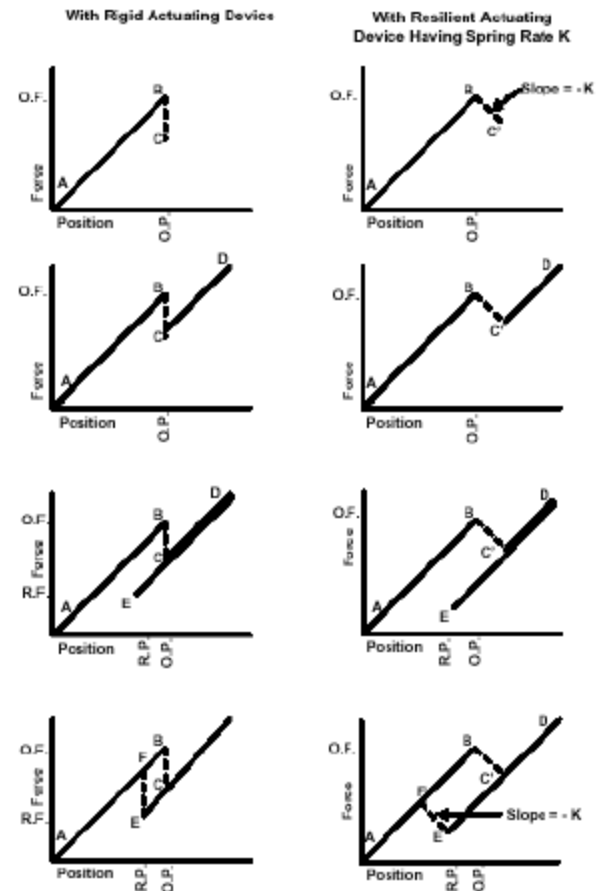
MECHANICAL SENSING - MICROSWITCH



MICROSWITCH OPERATION



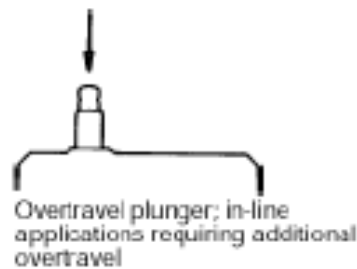
Switch exhibits mechanical hysteresis.



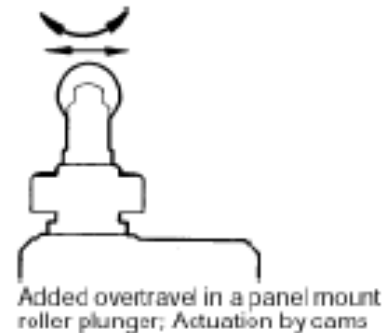
MICROSWITCH ACTUATORS



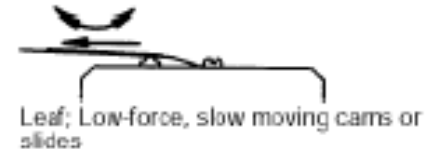
Pin plunger; in-line motion



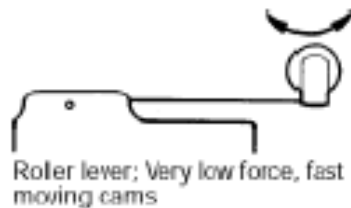
Overtravel plunger; in-line applications requiring additional overtravel



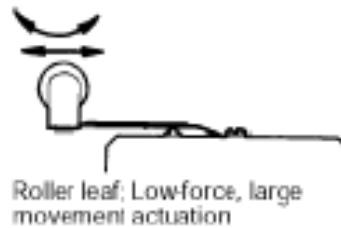
Added overtravel in a panel mount roller plunger; Actuation by cams



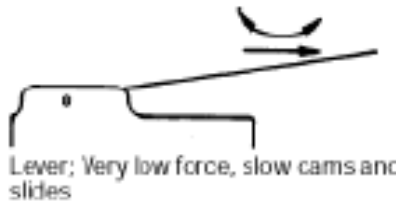
Leaf; Low-force, slow moving cams or slides



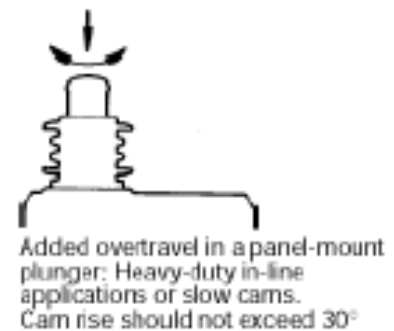
Roller lever; Very low force, fast moving cams



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°

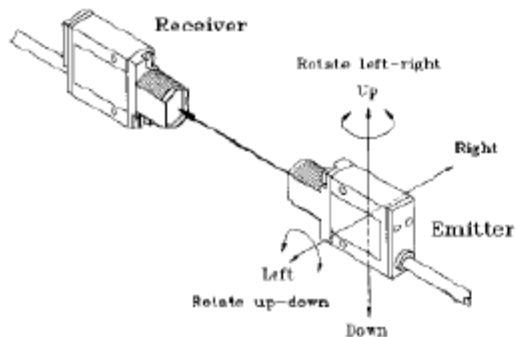
OPTICAL SENSING

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

TRANSMISSIVE & REFLECTIVE SENSORS

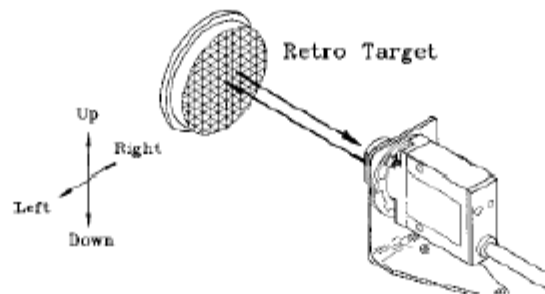
Opposed Mode Alignment

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



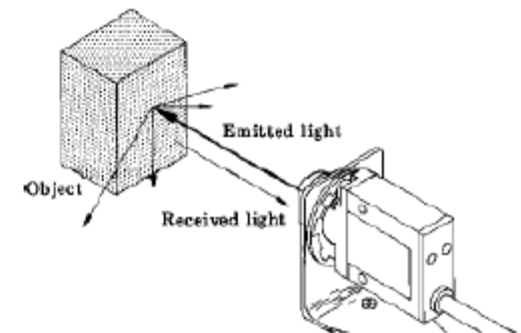
Retroreflective Mode Alignment

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

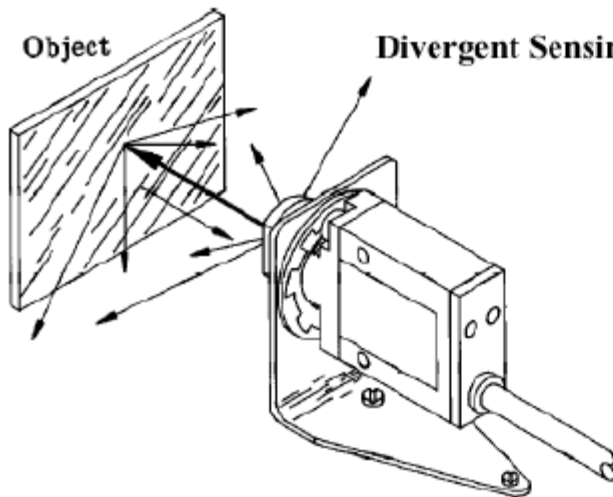


Proximity (Diffuse) Mode Alignment

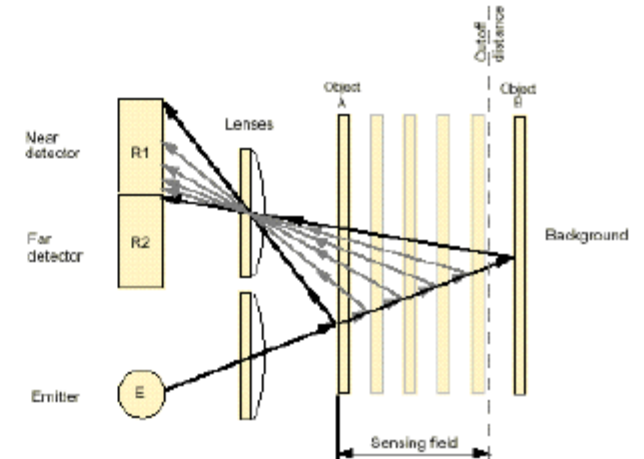
Diffuse Mode Alignment: Rotate Up-Down, Left-Right



Object Divergent Sensing Mode



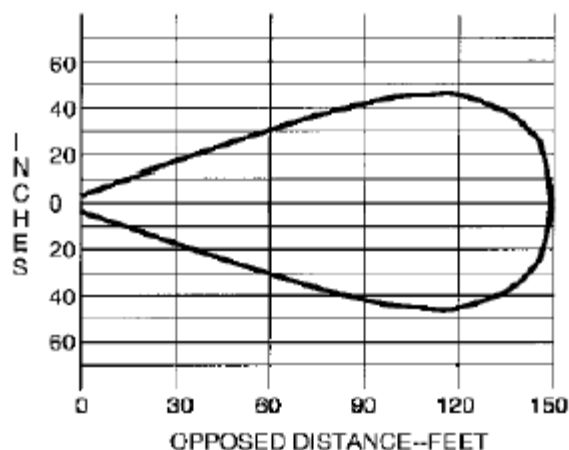
Fixed-field Diffuse Sensing



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

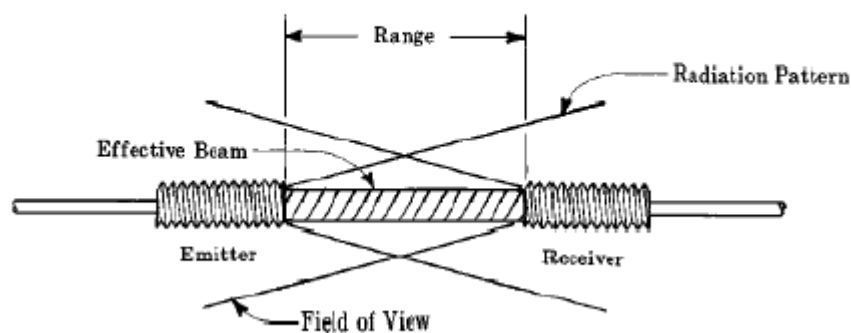


RELATIVE REFLECTIVITY TABLE

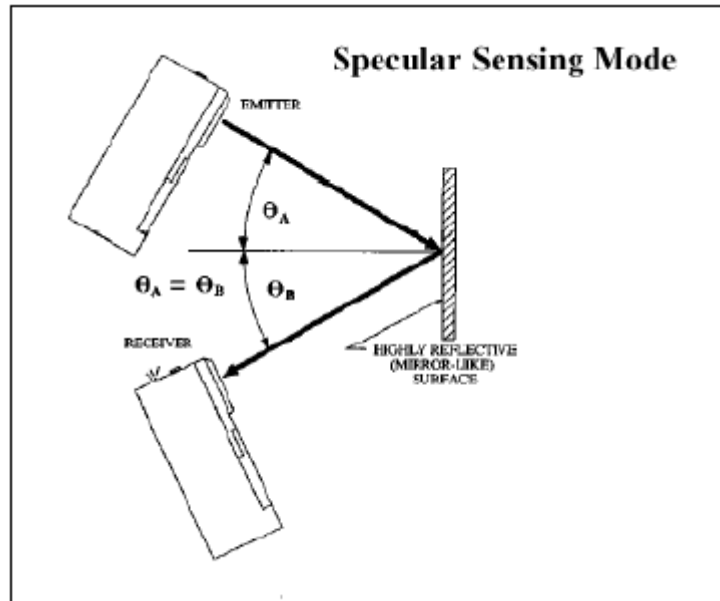
<u>Material</u>	<u>Reflectivity (%)</u>	<u>Excess Gain Required</u>
Kodak white test card	90%	1
White paper	80%	1.1
Masking tape	75%	1.2
Beer foam	70%	1.3
Clear Plastic*	40%	2.3
Rough wood pallet (clean)	20%	4.5
Black neoprene	4%	22.5
Natural aluminum, unfinished*	140%	0.6
Stainless steel, microfinish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



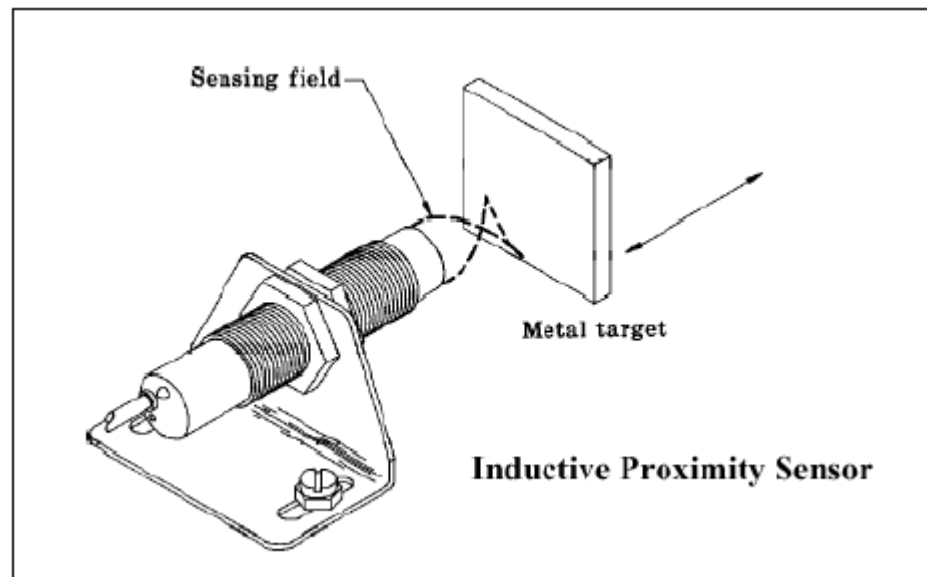
MODULATION

- “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

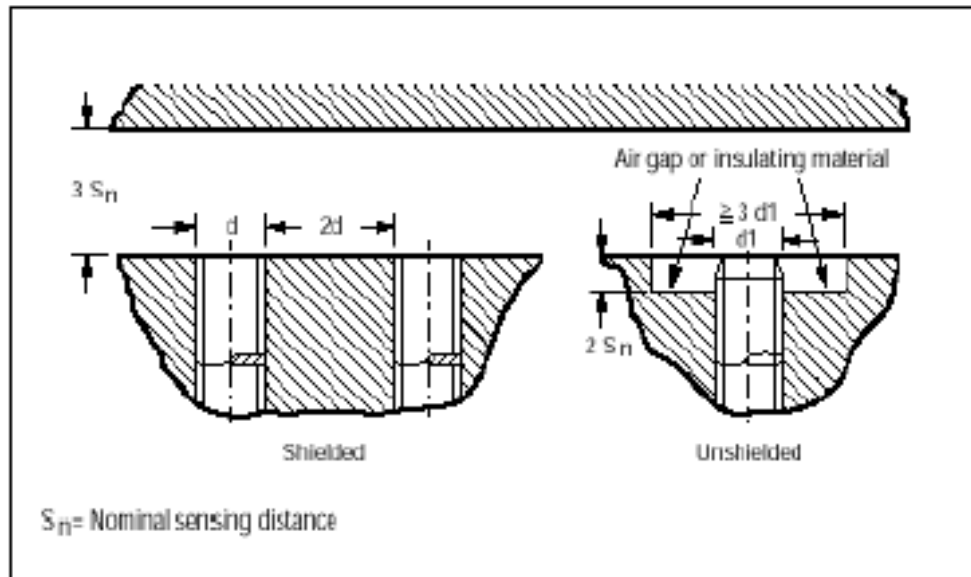
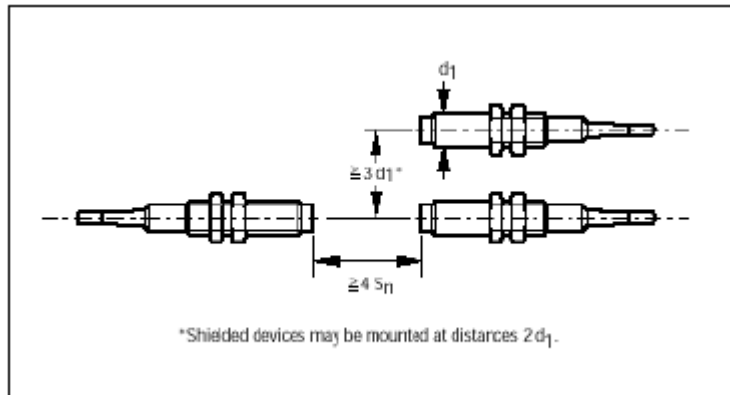
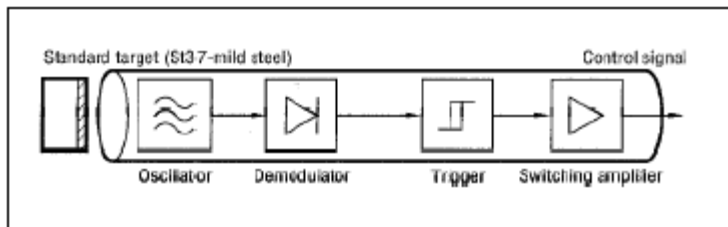
MAGNETIC POSITION SENSORS

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

INDUCTIVE PROXIMITY SENSOR



INDUCTIVE PROXIMITY SENSORS



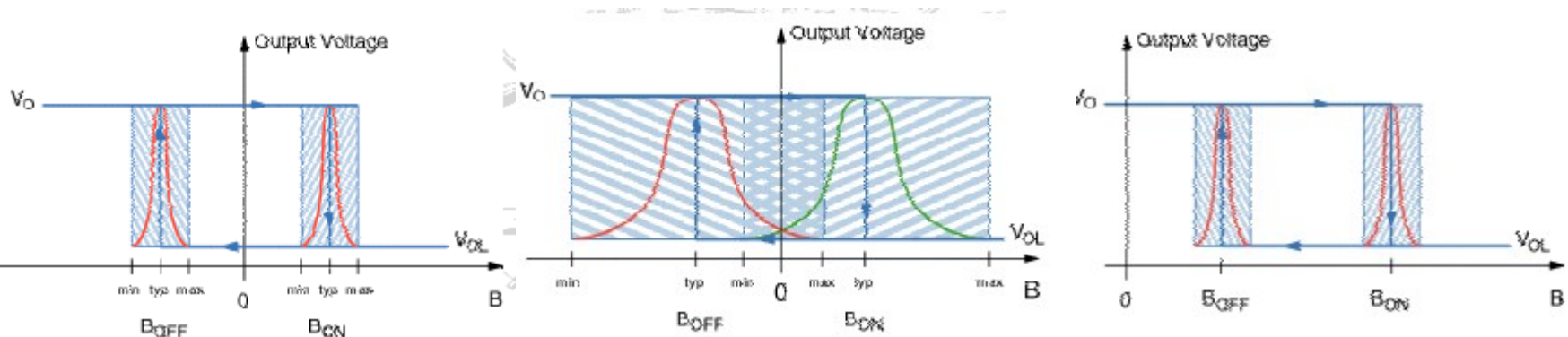
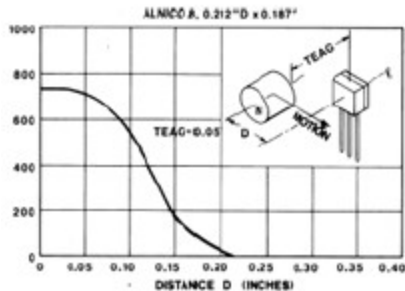
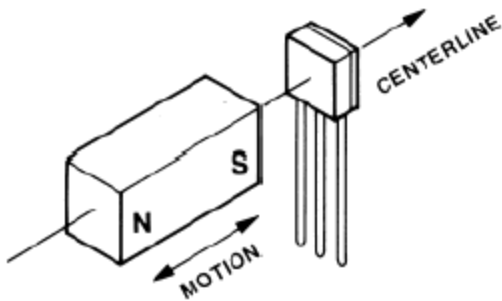
HALL SENSORS

- 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



HALL SWITCH

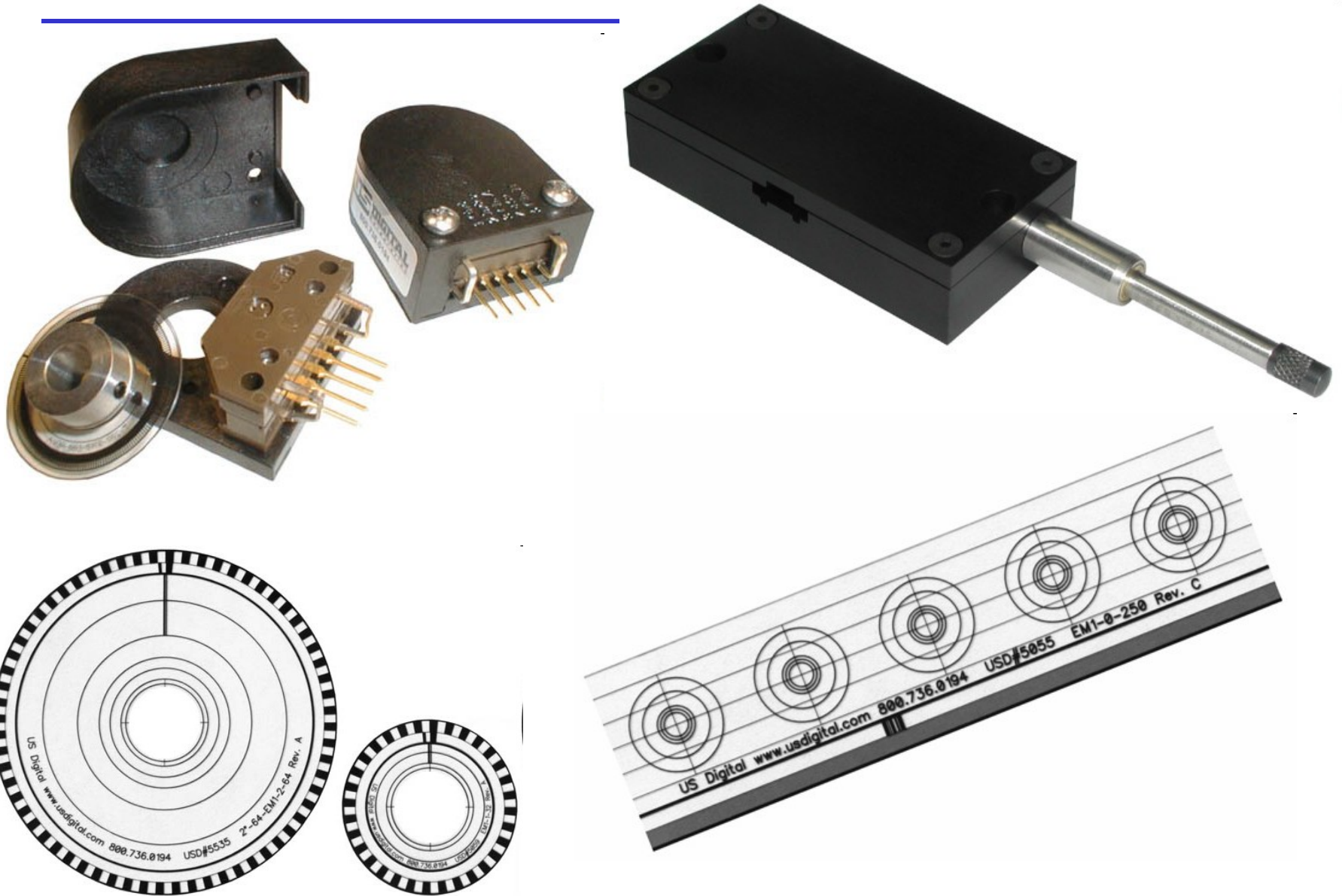
- Magnet motion
 - head-on
 - bypass or slide-by
- Total effective air gap (TEAG)
- Sensitivity, Hysteresis, & Temperature



OTHER DISCRETE POSITION SENSORS

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

INCREMENTAL ENCODERS

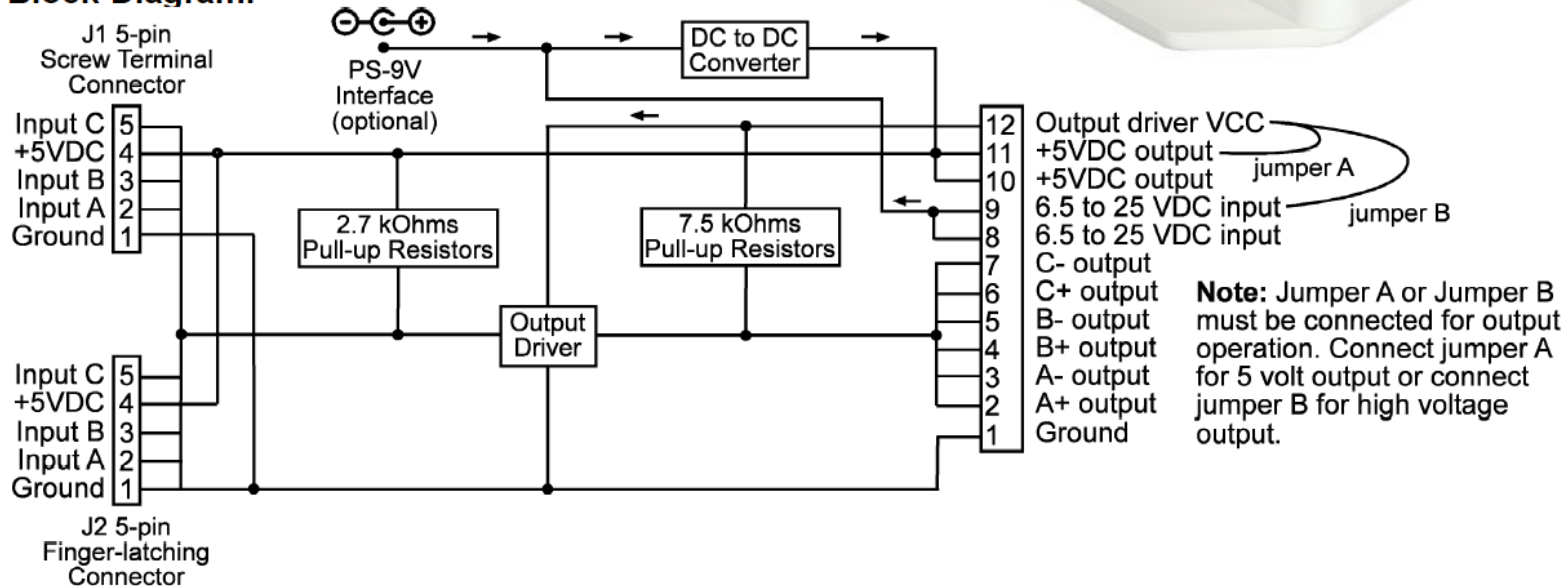


INCREMENTAL ENCODERS

- Encoders typically run on +5V, not +24V
- Outputs are typ. not 24V compatible either

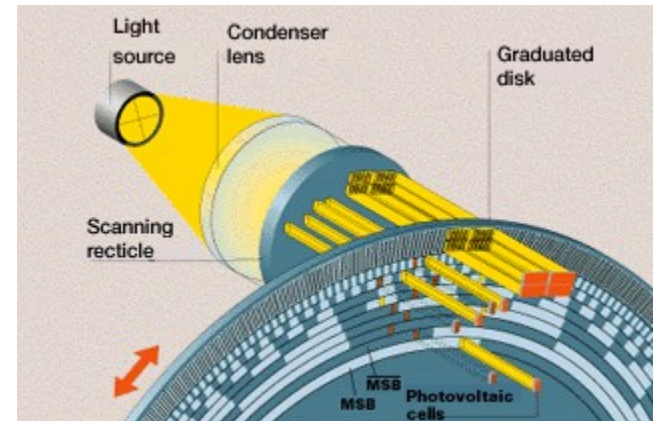
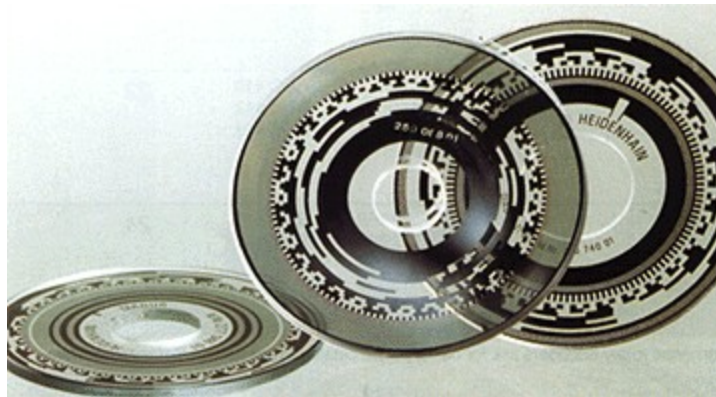


Block Diagram:



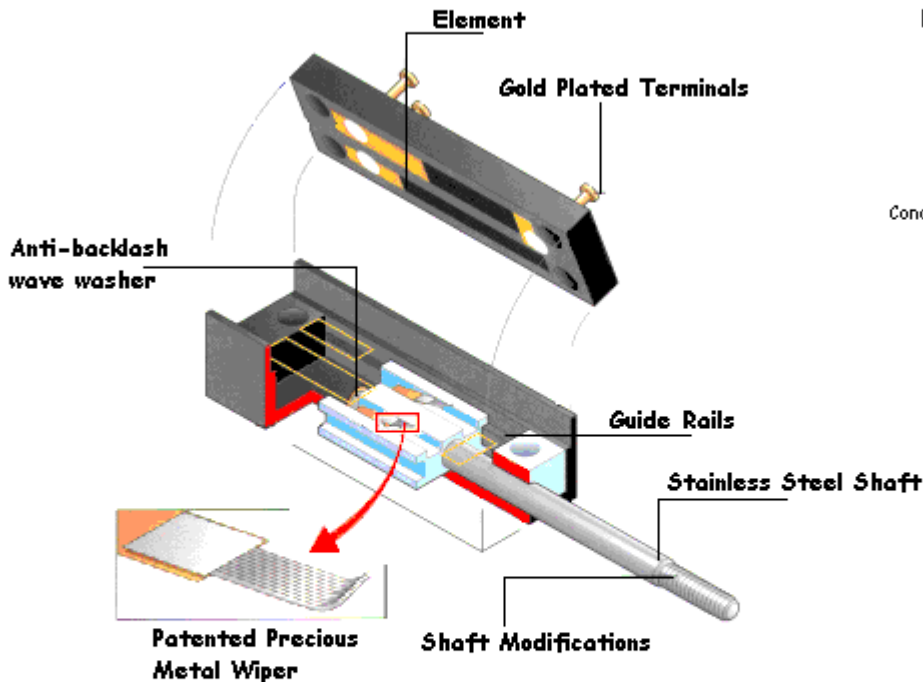
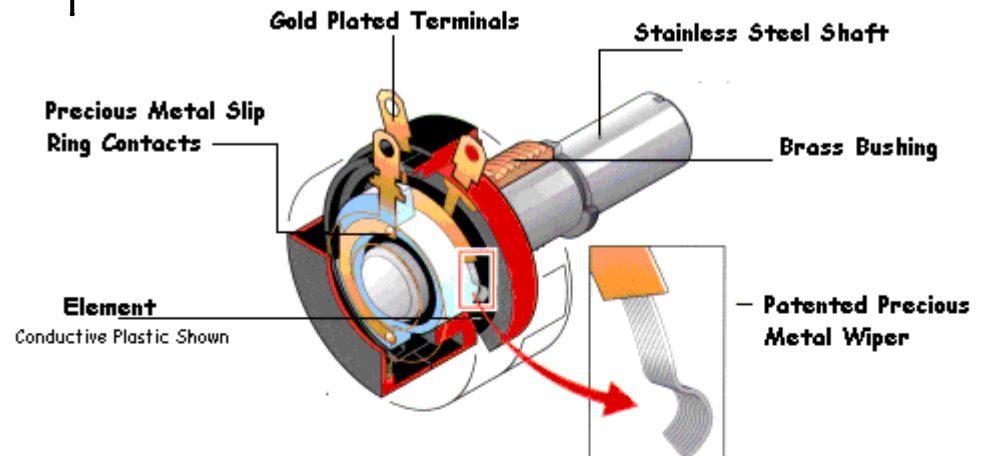
ABSOLUTE ENCODERS

- doubling resolution requires adding another photodiode/LED pair
- cost is much higher than incremental
- does not require seeking to establish reference location



POTENTIOMETER

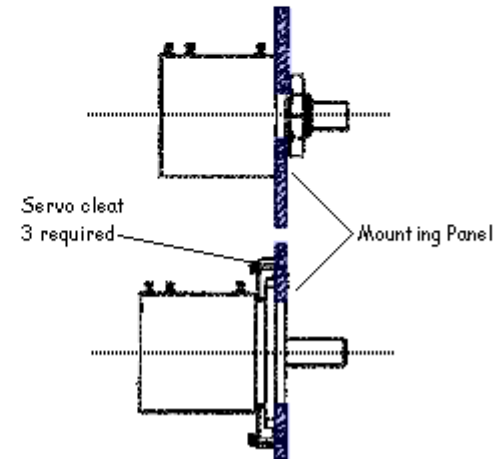
- A potentiometer (or pot) is a variable resistor wired to obtain a variable DC voltage proportional to position



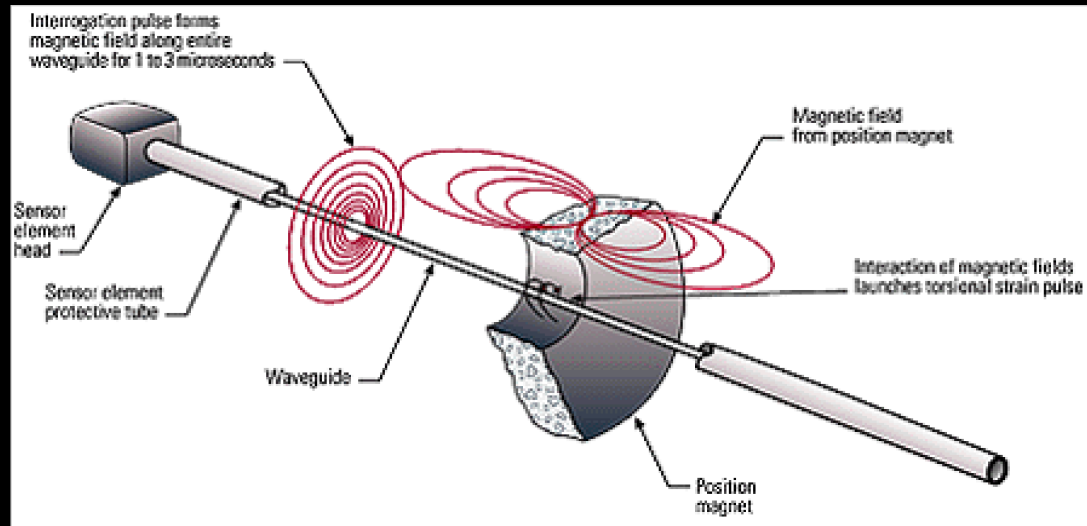
Mounting Types

Bushing mount : Most commonly used. Mounts easily in the panel hole and secures with a mounting nut.

Servo mount : Recommended when the shaft is to be attached to a gear or other mechanism. Allows the operator to index to zero adjustment by turning the potentiometer.



MAGNETOSTRICTIVE POS. SENSOR



MAGNETOSTRICTIVE SENSOR

