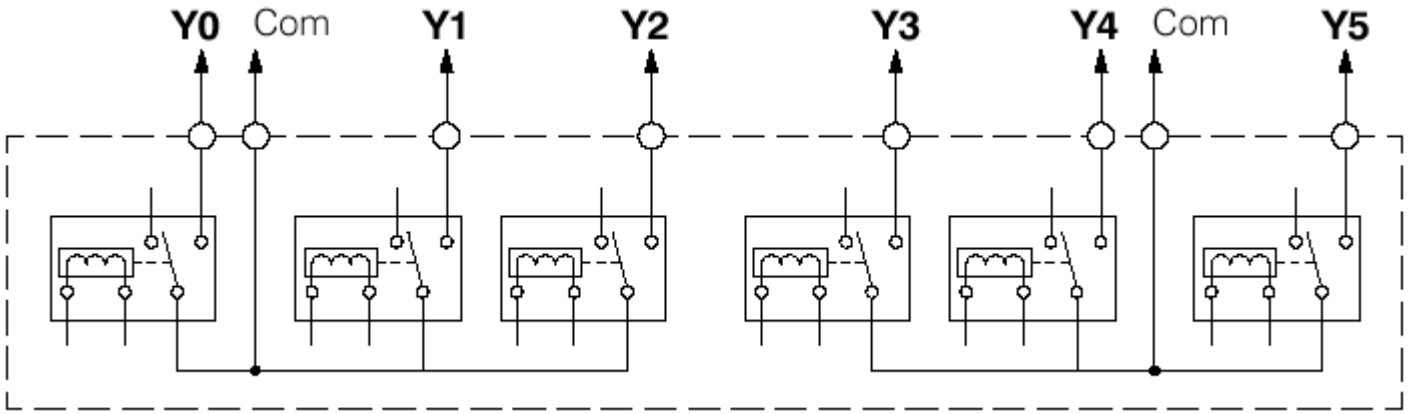
Relay Outputs

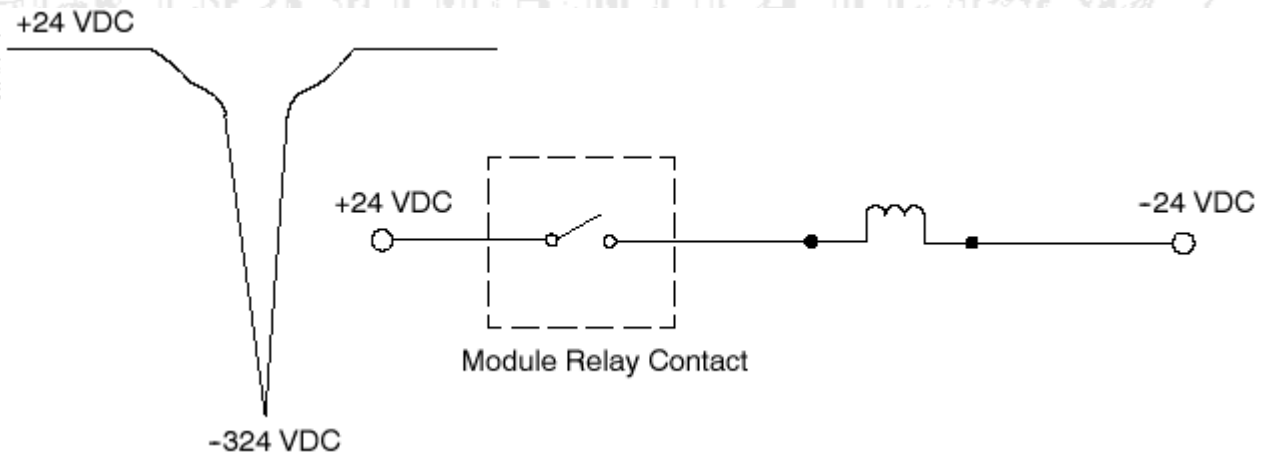


- *If you need both AC and DC, or higher current or voltage, use the relay output model.*
- *DL05AR or DL05DR:*
  - *6-240VAC, 6-27VDC*
  - *0-2A/contact, 6A/common*
- *Slower than DC outputs (15mS vs. 30µS)*

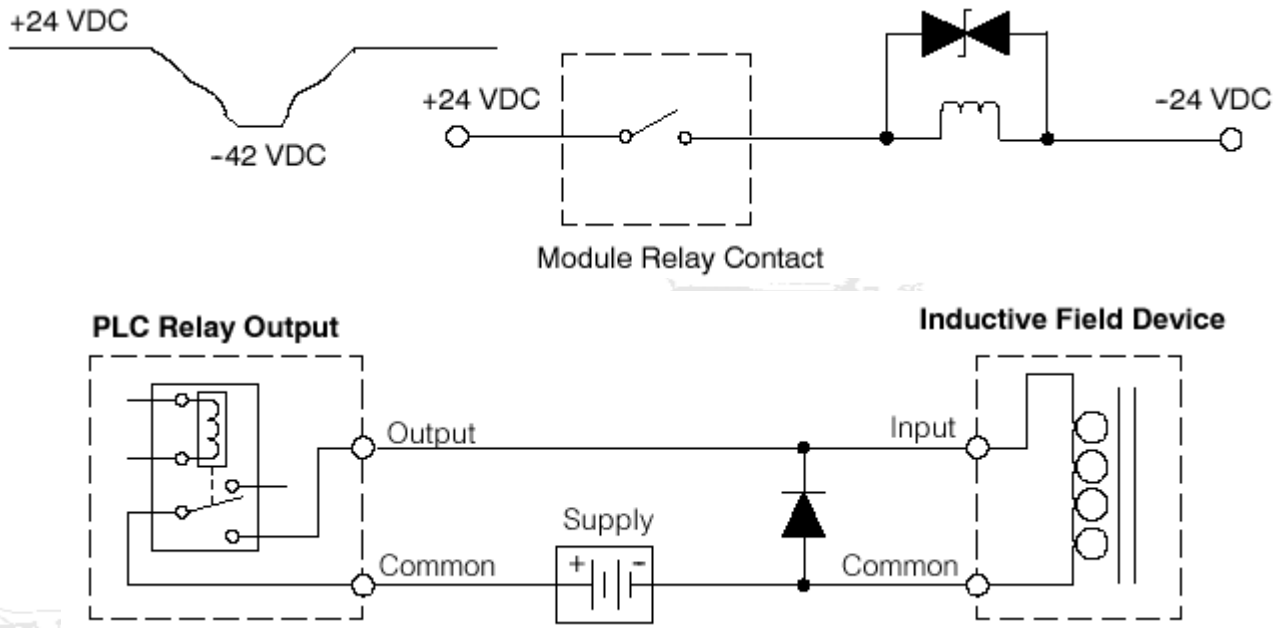
Output Protection

- *DC outputs need fuse protection*
- *Relay contacts need inductive transient protection*

$$V = -L\frac{di}{dt}$$



Inductive Transients

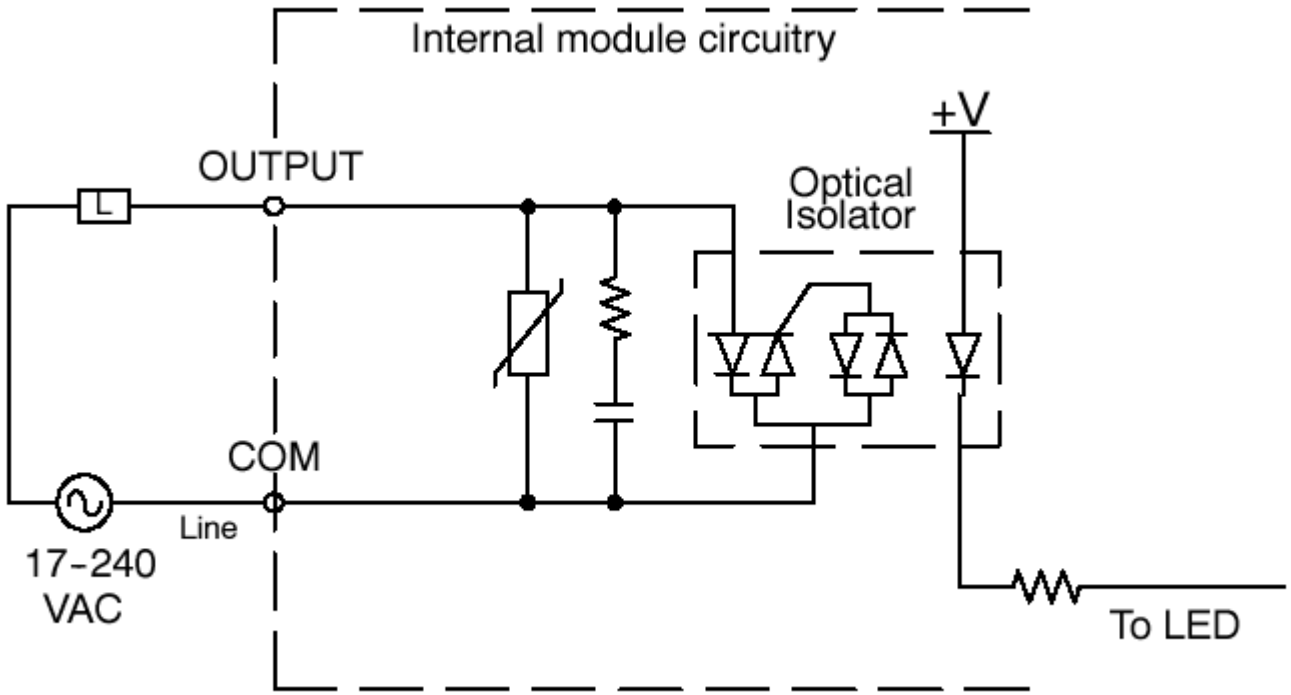


- *TVS (Transient Voltage Suppressor) or MOV (metal oxide varistor) for AC*
- *Diode for DC*

Motor Starting

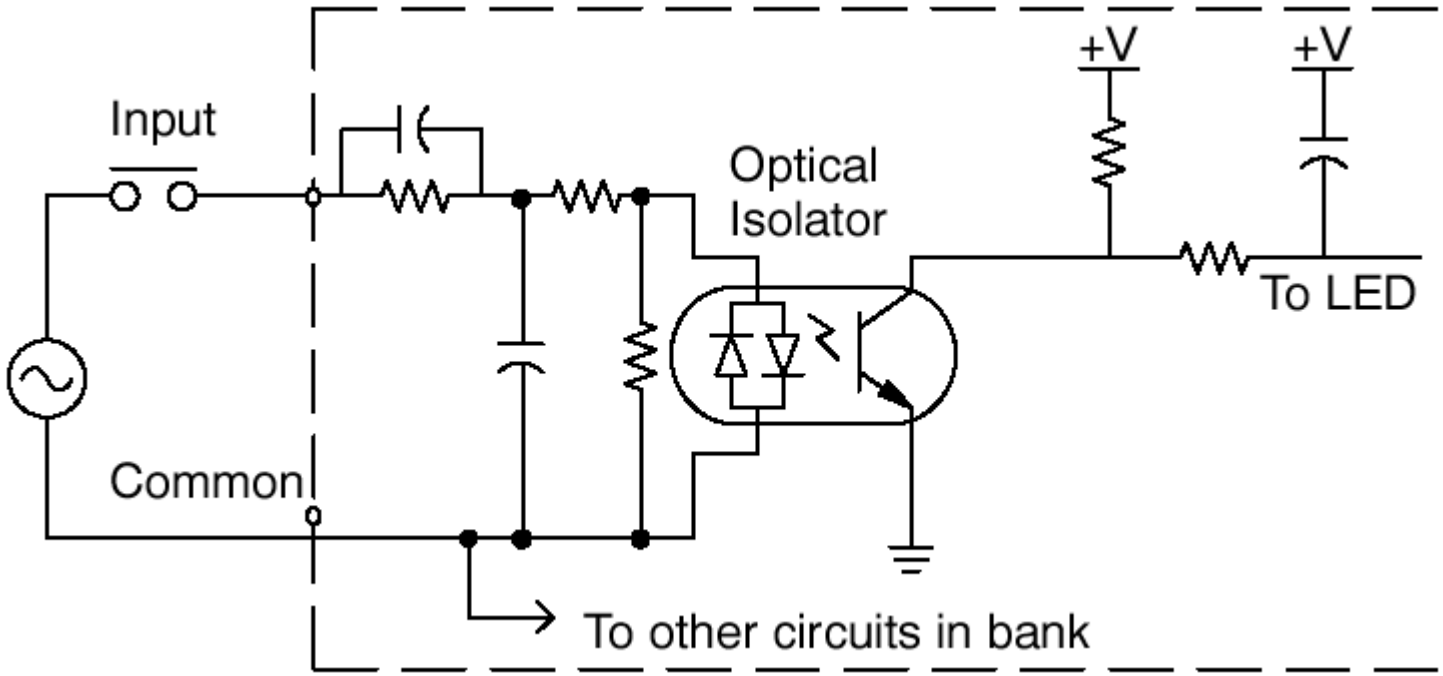
- *Motors take a huge current to start (typ 3x run current)*
- *Normal relay contacts get welded by even "small" motors*
- *Use "Contactors" or "Motor Starters"*

AC Outputs



Triac switch turns on or off at AC zero voltage points.

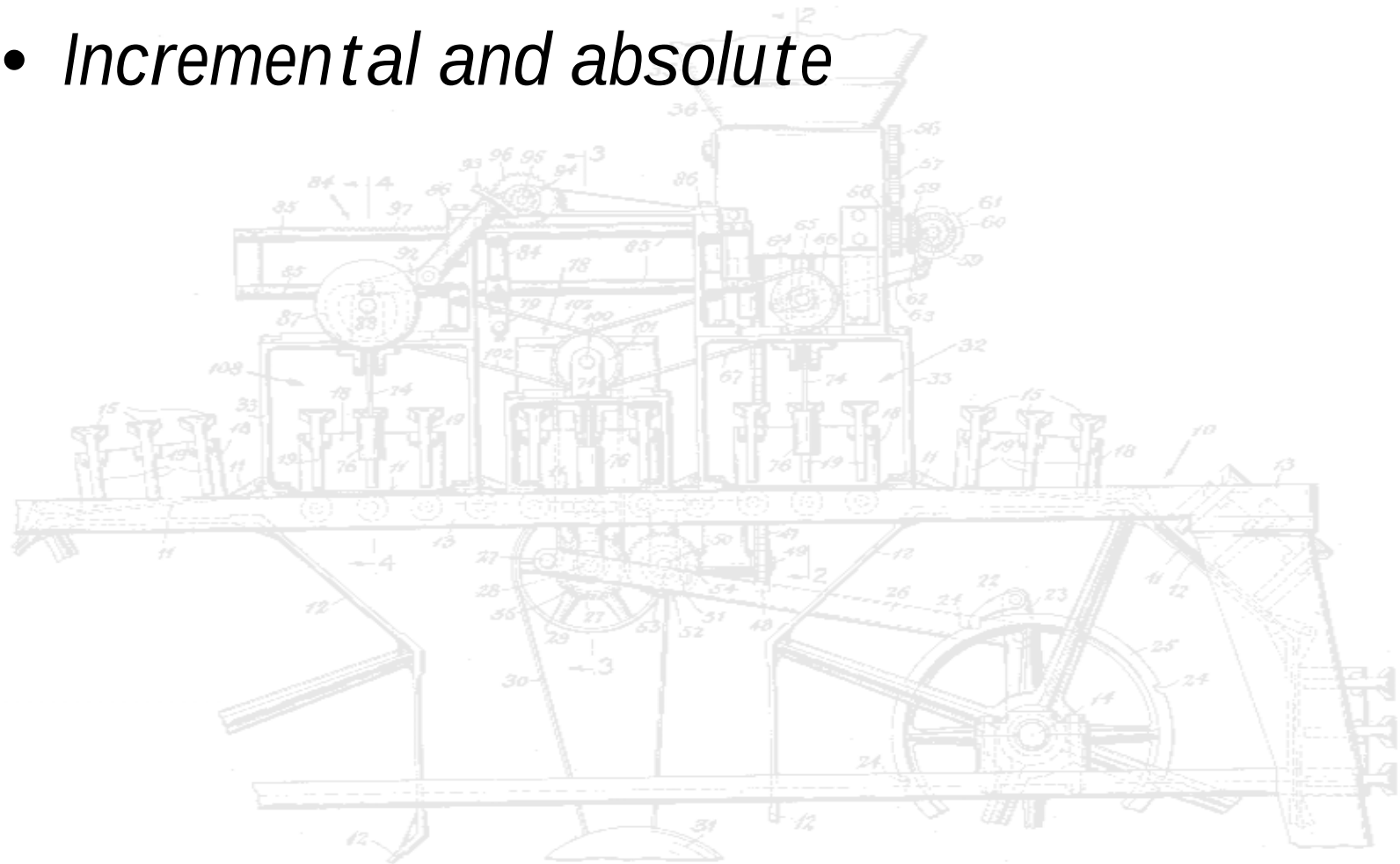
AC Inputs



- *Voltage divider and filter in front of sourcing/sinking DC input.*
- *Slow response! Up to 8.3msec delay.*

Proportional Feedback

- *Direct vs. Indirect Measurement*
- *Continuous vs. Discrete sensors*
- *Incremental and absolute*



Direct vs. Indirect

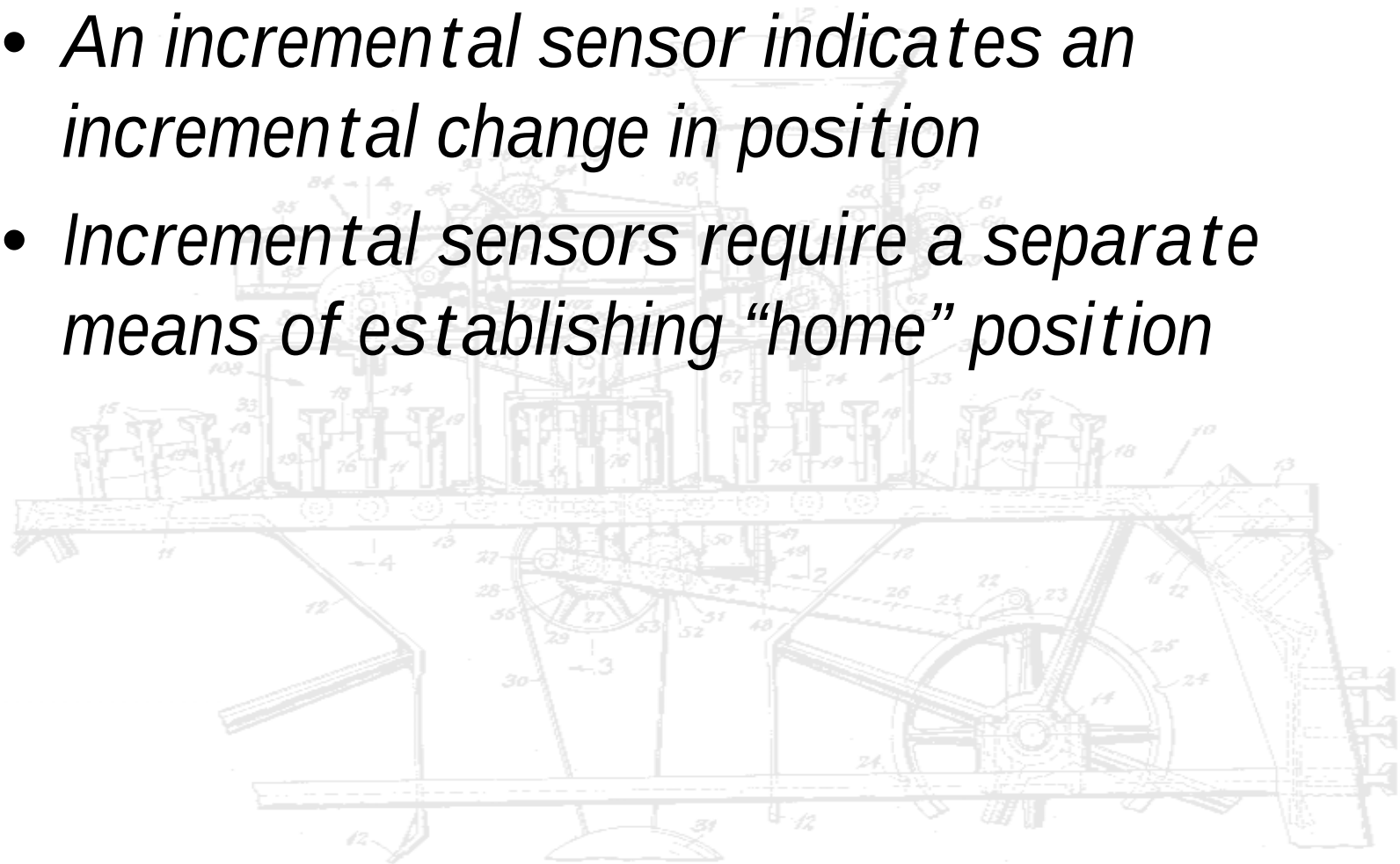
- *Measuring position of a carriage is better than measuring rotation of leadscrew*
- *Measuring level in a tank or weight of a product is better than measuring flow*
- *Measuring temperature of an oven is better than measuring heater current*
- *Budget usually dictates whether direct or indirect measurement will be used*

Continuous and Discrete Sensors

- *Most sensors are analog, and give readings on a continuous scale that must be quantized for use with a PLC.*
- *Position sensing can be done with encoders that give a quantized reading to start with*
- *Linearity and temperature coefficient are usually limiting factors on accuracy of continuous, analog sensors. Discrete sensors are limited by resolution.*

Absolute vs. Incremental

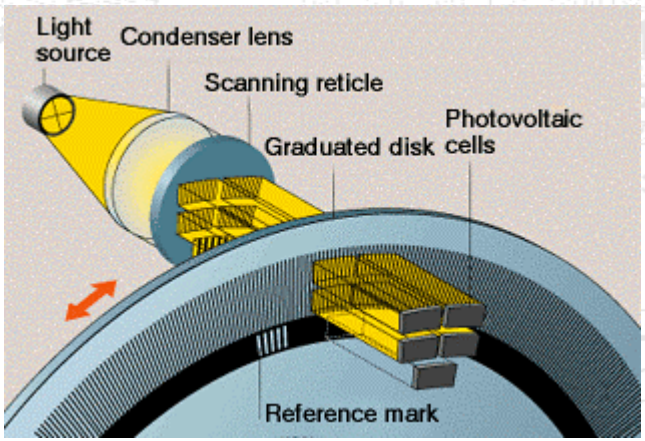
- *An absolute sensor gives a single, unambiguous reading for a given position*
- *An incremental sensor indicates an incremental change in position*
- *Incremental sensors require a separate means of establishing "home" position*

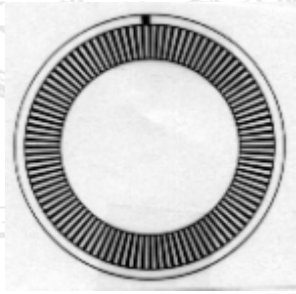


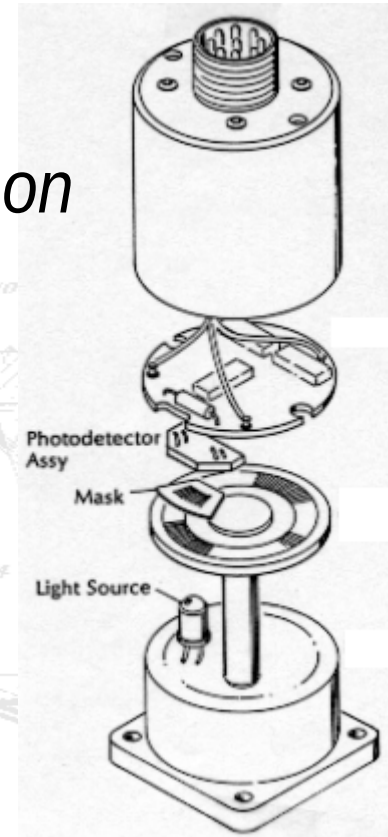
Incremental Encoders

Incremental encoders give relative position information

- *count + and - relative motion*
- *index pulse gives a once-per-revolution signal*
- *Resolution = 4x number of slots*
- *establish absolute ref point each power-on*







Incremental Encoders

- *Quadrature signal outputs*
- *Single-ended vs. differential output*