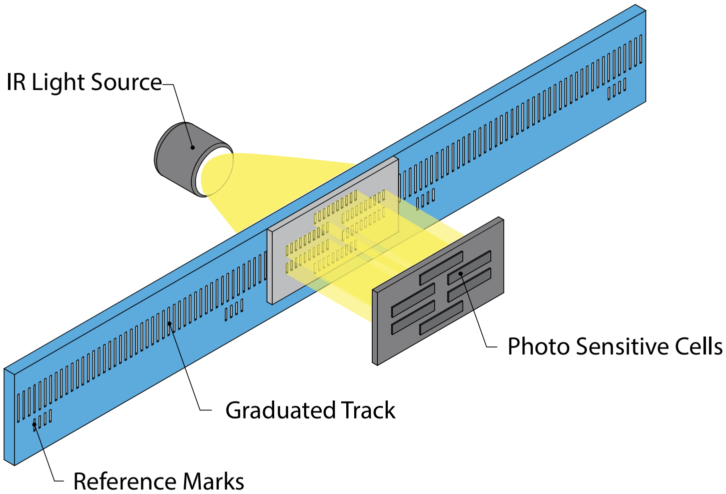
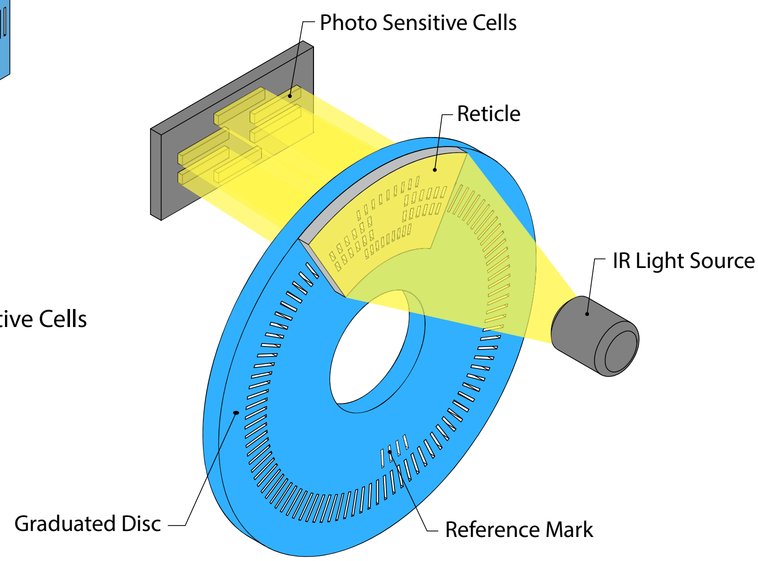
Optical Scanning Principle





An encoder's most important components include a light source, scanning reticle, gratings, and a photosensitive sensor. The gratings can be arranged in a circular shape—for example, angle and rotary encoders—or along straight path in linear encoders. Typically, the scanning reticle and grating used in an encoder are matched to have equal periods.

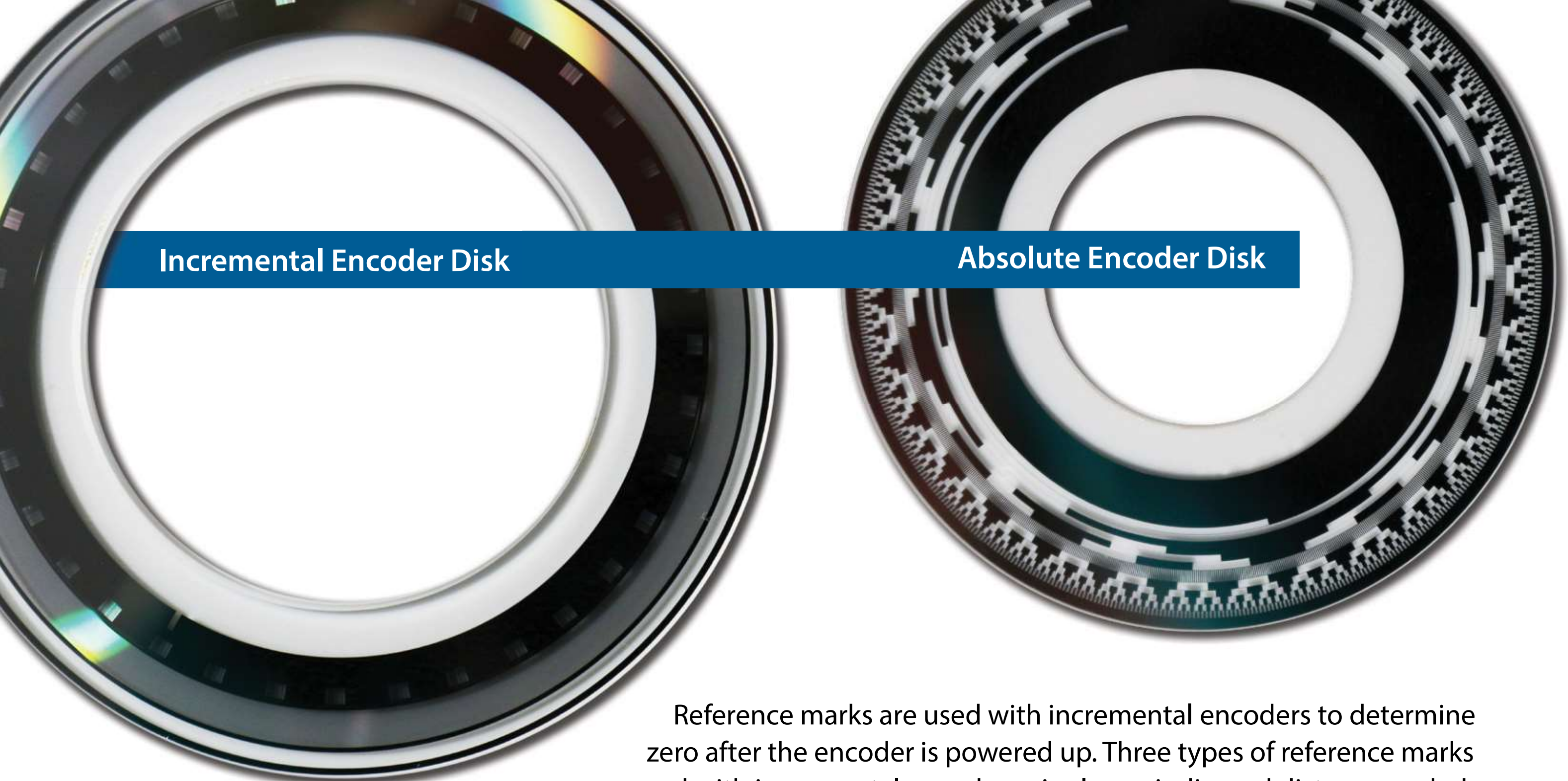
Throughout an encoder's operation, light is continually projected, usually from an LED via an optical collimator. The scanning reticle moves in relation to the grating pattern, either rotationally or linearly, producing sine-wave like variations in light intensity.

The light sensor is comprised of photovoltaic cells. As the reticle or grating moves, each cell receives a periodic signal of fluctuating light. These signals are averaged over the large scanning area to minimize effects of local contamination.

The electronic processing unit performs further amplification, signal conditioning, zero crossing detection and/or interpolation to provide output signals for the required format and resolution.

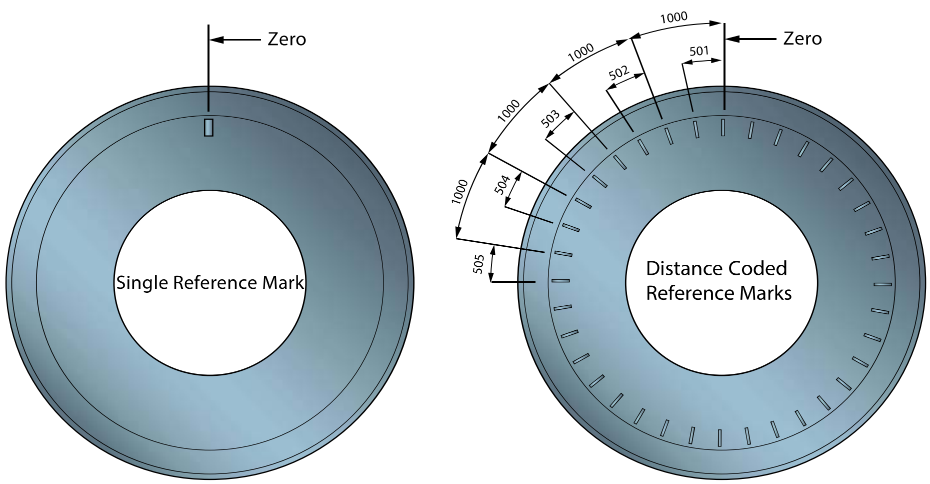
The Digital Readout or user-supplied automation equipment interpret the encoder signal and convert it to linear or angular position. Linear or rotational speed, as well as acceleration, can be calculated by further processing.

Incremental encoders have a periodic grating pattern and generate an output pulse each time the encoder moves a certain fraction of the grating period. The output pulses are counted and the amount of motion is calculated. Counting begins at zero or a predetermined number each time the encoder is powered up, while any motions that occur while the encoder is powered off are unaccounted for.



Reference marks are used with incremental encoders to determine zero after the encoder is powered up. Three types of reference marks are used with incremental encoders: single, periodic, and distance-coded.

In case of single marks, entire encoder has just one mark, and exact zero can be established by monitoring reference output after crossing the mark. Single marks are commonly used on rotary encoders. However, they can be disadvantageous when used on linear encoders, since a long distance must be traveled before zero is established.



Periodic reference marks are often used on linear encoders and are repeated after a certain distance (typically 50mm). While this approach provides some flexibility in choosing which mark to use, establishing zero, again, may require long travel, and moreover, a mechanism to ensure that the same mark is always used as a reference must be implemented.

Distance-coded reference marks are uniquely spaced along the encoder, using a certain mathematical algorithm, typically with distance between each set of marks progressively decreasing by 1 grating period. This allows reestablishment of the absolute position with only minimal movement. Distance-coded reference marks are extensively used on both linear and angle encoders.

Absolute encoders can determine exact position without moving, even immediately after being powered up. Their gratings feature either multiple tracks forming a Binary/Gray Binary code or a pseudorandom sequence. Output is transmitted digitally, usually by some form of a serial data protocol, either continuously or on request.

Absolute encoders do not lose their position if moved without power, so even if the machine axis is moved while the encoder is turned off, the exact position is immediately known once the power comes back on. Neither execution of homing procedures nor motion is required. This makes them well-suited for many critical and safety-related applications.