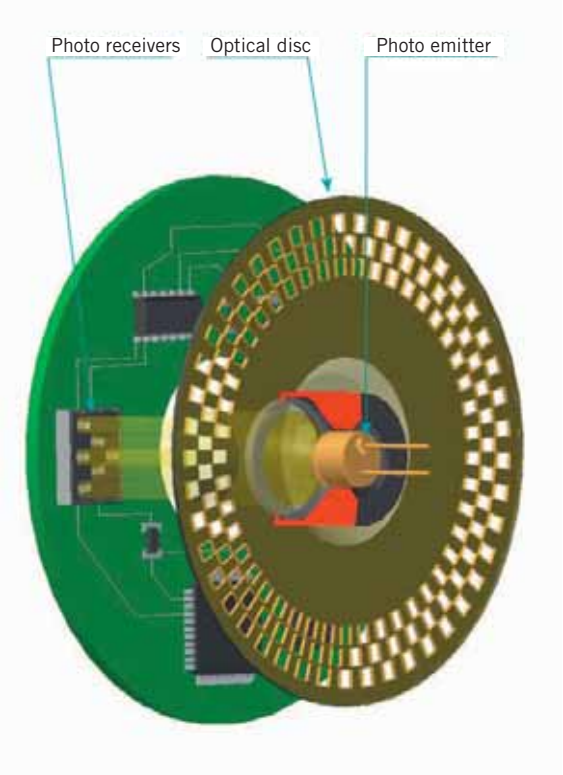
INCREMENTAL ENCODER
GENERAL DESCRIPTION

ISO 9001:2000

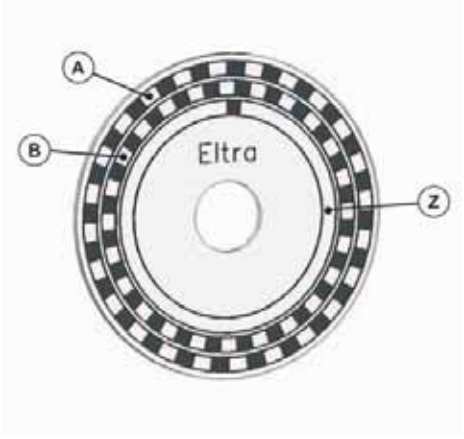
Working principle

An encoder is a rotational transducer converting an angular movement into a series of electrical digital pulses. If associated to racks or endless screws, these generated pulses can be used to control angular or linear movements. During rotation, electrical signals can be elaborated by numerical controls (CNC), programmable logic controls (PLC), control systems, etc. Main applications of these transducers are: machinery, robots, motor feedback, measure and control devices. In Eltra's encoders the angular movement transduction is based on the photoelectric scanning principle. The reading system is based on the rotation of the radial graduated disk formed by opaque windows and transparent ones alternated. The system is perpendicularly illuminated by an infrared light source. The light projects the disk image on the receivers surface which are covered by a grating called collimator having the same disk steps. The receivers trasduce the light variation occurring with the disk shifting, converting them into their corresponding electrical variations. Electrical signals raised to generate squared pulses without any interference must be electronically processed. The reading system is always carried out in differential modality, in order to compare different signals nearly identical but out of phase for 180 electrical degrees. That in order to increase quality and stability of output signals . The reading is designed comparing the difference between the two channels eliminating the disturb note as "shifted common way" because signals are overlapped in equal way on every kind of wave.



Incremental encoders

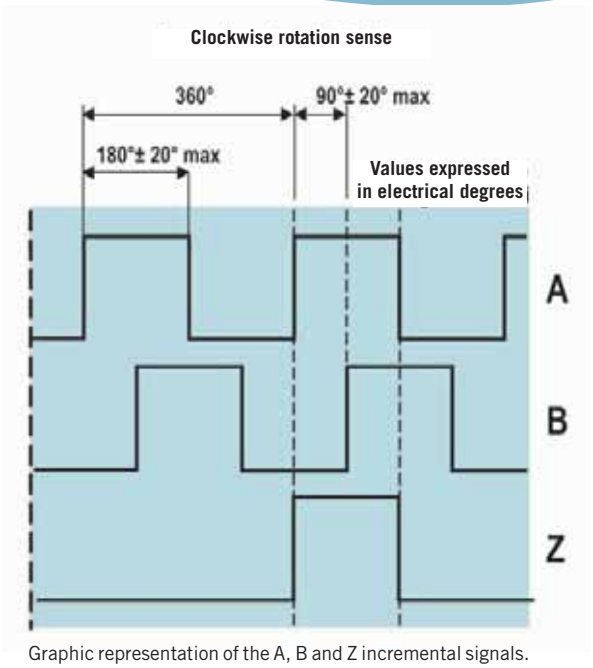
The incremental encoder usually gives two types of squared waves out of phase for 90 electrical degrees. They are usually called channel A and B. The first channel gives information about the rotation speed while the second, basing on the states sequence produced by the two signals, provides the sense of rotation. A further signals, called Z or zero channel, is also available. It gives the absolute zero position of the encoder shaft. This signal is a squared impulse with the phase and the width centred on A channel.



The incremental encoder precision depends on mechanical and electrical factors. These errors could be: grating division, disk eccentricity, bearings eccentricity, electronic reading and optic inaccuracy. The measurement unit to define encoder precision is the electrical degree. It determinates the division of the impulse generated by the encoder: 360 electric degrees correspond to the mechanical rotation of the shaft which is necessary to carry out a complete cycle. To know how many mechanical degrees correspond to electrical 360° the following formula has to be applied:

$$\text{Electrical } 360° = \frac{\text{Mechanic } 360°}{\text{n° pulse / turn}}$$

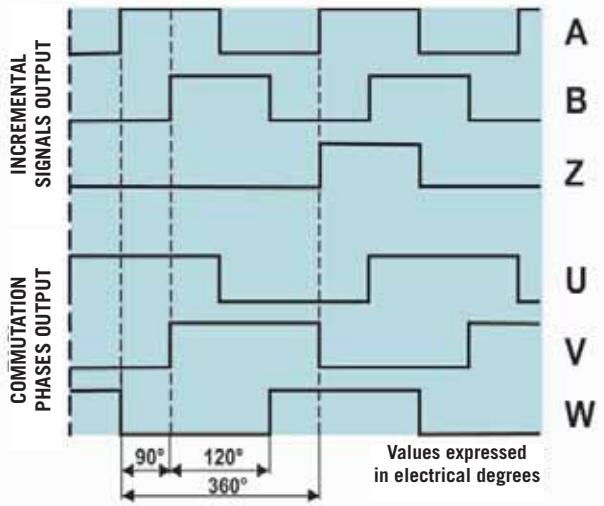
The encoder division error is given from the maximum shifting shown in the electrical degrees of two consecutive surges. This error exists in any encoder and is due to the above mentioned factors. For Eltra's encoders this error is included in electrical +/- 25° Max in whatever allowed condition, which corresponds to a shifting of +/- 7 % from the nominal value. Regarding the 90 electrical degrees shifting between the two channels, it differs by +/- 35 electrical degrees Max. It corresponds to +/- 10 %.



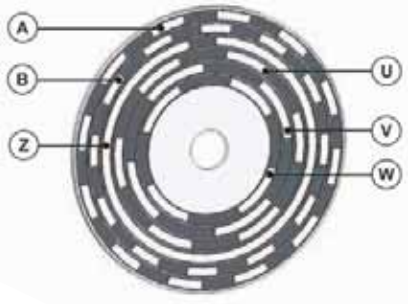
Graphic representation of the A, B and Z incremental signals.

Incremental encoder with integrated commutation phases

In addition to the above mentioned encoders, there are others which integrate additional electrical output signals. These are the incremental encoders with integrated commutation signals, used as motor feedback. These additional signals simulate the Hall phases generally present in the commutation motors (brushless type) and usually designed with magnetic sensors. In Eltra's encoders these commutation signals are optically generated and presented as three squared waves, shifted by 120° electrical degrees. These signals will be used by the driver control to the motor in order to generate the correct voltages phase to determinate the correct rotation. These commutation pulses can be repeated many times within one mechanical rotation because they directly depend on the poles number in the connected motor. So we have commutation phases for motors of 4, 6 or more poles.



Graphic representation of A, B and Z incremental signals with commutation U, V and W.



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