

When and why using an encoder

Introduction

The strength of a stepper motor is that it does not need any electronics to control the position of the rotor. As one step is realized each time, it is enough to count the number of steps that are achieved during one second to know the exact position of the rotor.

However, some questions remain:

- Does the motor actually achieve the right amount of steps?
- What happen if it loses steps?
- What if one wants a feedback for security reasons?

To answer them, the right solution is often to use an encoder in order to check the position of the rotor. Therefore, the idea of this application note is to present the different encoders compatible with PRECstep® stepper motors and explain their characteristics.

PRECstep® encoders

Today, only the AM0820, AM1020, AM1524 and AM2224 have the possibility to be assembled with an encoder and an encoder for the DM0620 could be developed in the future. Please find below the different encoders possibilities:

Table 1 : Encoders suitable with PRECstep® stepper motors.

Motor	Encoder	Lines per revolution	Type
AM0820	IEM3-1024	120 or 1024	Magnetic
AM1020	AE30B19	10	Magnetic
AM1524	AE23B8 AE23B8-01 (Teflon leads)	12	Magnetic
AM2224	PE22-120	120	Optical

All those encoders can provide information about the velocity, position and direction of the rotor motion.

Ordering code

When ordering a motor with an encoder, one must pay attention that the encoder is compatible with the motor and then choose the right execution of the motor. Example:

AM10202R009012 AE30B19
 AM10202R009012 AE30B19
 AM10202R009012 AE30B19

Complete motor + encoder designation
 Motor execution, **must suit to encoder**
 Encoder designation. Might change from one model to the other

The motor execution is important since a longer shaft at the rear of the motor is mandatory to assemble the encoder.

How to choose an encoder?

There are some questions that you may ask yourself before choosing the proper encoder. Those are summarized below.

Optical or magnetic?

FAULHABER PRECISTEP proposes either magnetic or optical encoders.

Magnetic encoders use a magnetized wheel press fitted on the motor rear shaft that provides the magnetic field to the electronics. The electronics contains Hall sensors and comparators to analyze the information and returns two quadrature signals with a 90° phase difference. Such encoders ensure compactness and simple electronics. The magnet wheel can even be sensed with an external Hall sensor.

Optical encoders use a multi-section disk press fitted on the motor rear shaft and illuminated by a continuous infrared light source. It generates two quadrature signals with a 90° phase difference. Such encoders ensure low current consumption (ideal for portable solutions), light weight and insensitivity to magnetic interferences.

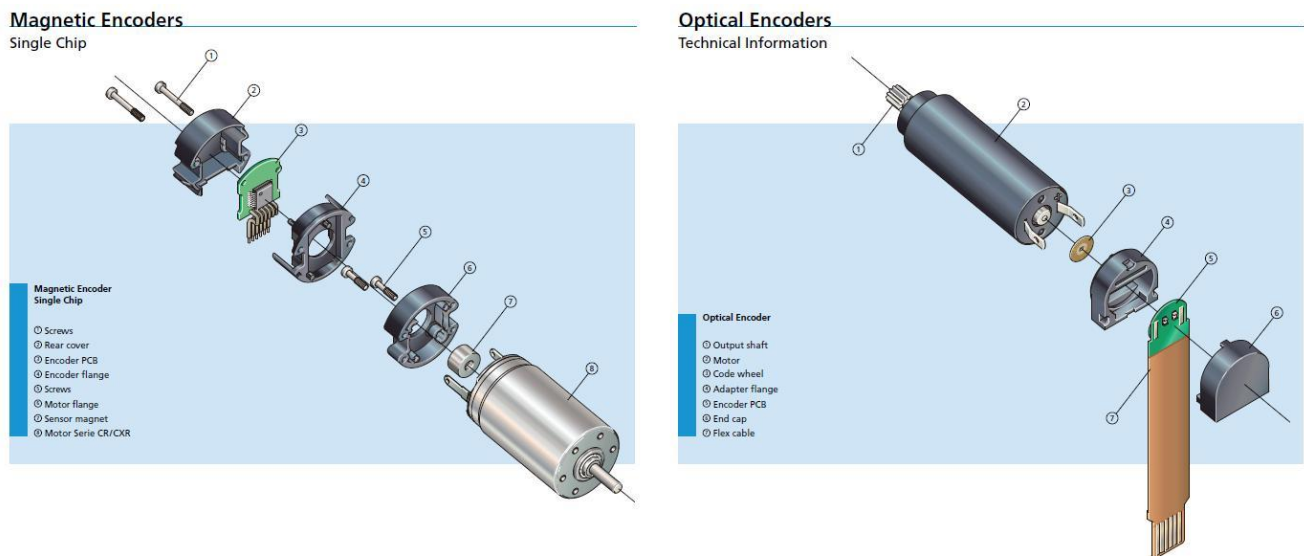


Figure 1 : (left) Magnetic and (right) optical encoders technologies.

How many lines per revolution?

The resolution in both channels must be at least equal to the number of steps per revolution of the stepper motor. Meaning that for a 20 steps per revolution motor, at least 10 lines per revolution per channel are mandatory.

- AE30B19 is designed for 20 steps per revolution stepper motors and AE23B8 for 24 steps per revolution motors.
- The PE 22-120 and the IEM3-1024 encoder are designed for either a 20 or 24 steps per revolution stepper motor as they have a higher resolution of 120 (or 1024) lines per revolution. However, they are designed for the AM2224 and the AM0820 exclusively at the moment.

An encoder has basically 3 functions:

1. Verify that a stepper motor is not losing steps and control its position
2. Act as a commutation system in order to use the stepper motor as a brushless motor
3. Achieve a precise positioning (less than a step resolution)

Depending on which function your encoder was selected for, the resolution will not be the same. For function 1 and 2, having 10 or 12 lines per revolution for a stepper motor with respectively 20 or 24 steps per revolution is enough. For function 3, the more lines per revolution you can use, the more accurate your positioning control will be.

Therefore, PRECISTEP® “AE” encoders are mostly designed for function 1 and 2 and the PE22 and IEM3 encoders for functions 1-3.

Absolute or incremental encoder?

FAUHLABER PRECISTEP mostly proposes incremental encoders since the position of the stepper motor can be known by counting the steps (increments) realized by the rotor. However, the encoder IEM3 can be used either in incremental or absolute mode.

All encoder solutions can be found on our website www.faulhaber.com.

Custom encoders

In many cases, the encoder is only useful to control that the motor is rotating and not losing step. The cheapest solution is then to build its own encoder. This is possible by fixing a magnet at the rear shaft of the motor and sensing the rotation with a Hall sensor (custom magnetic encoder). Another cheap and simple solution is to fix a plastic component at the rear of the motor and optically detect the rotation (custom optical encoder).

An example of such custom made optical encoder is presented in Figure 2.

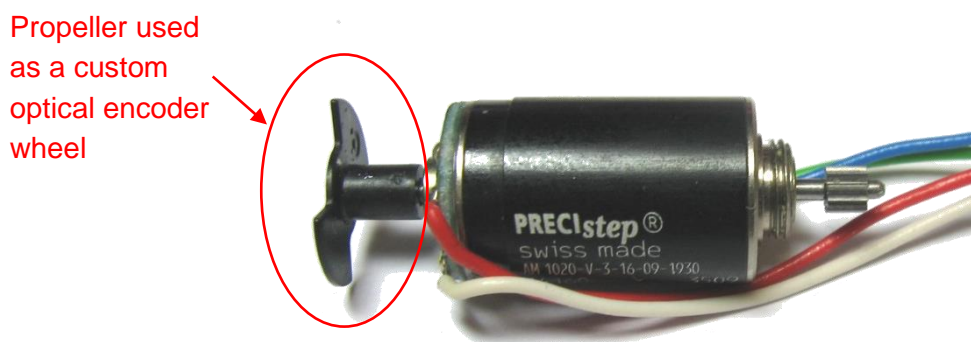


Figure 2 : Motor with a plastic propeller on the rear shaft for a custom optical encoder solution.

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