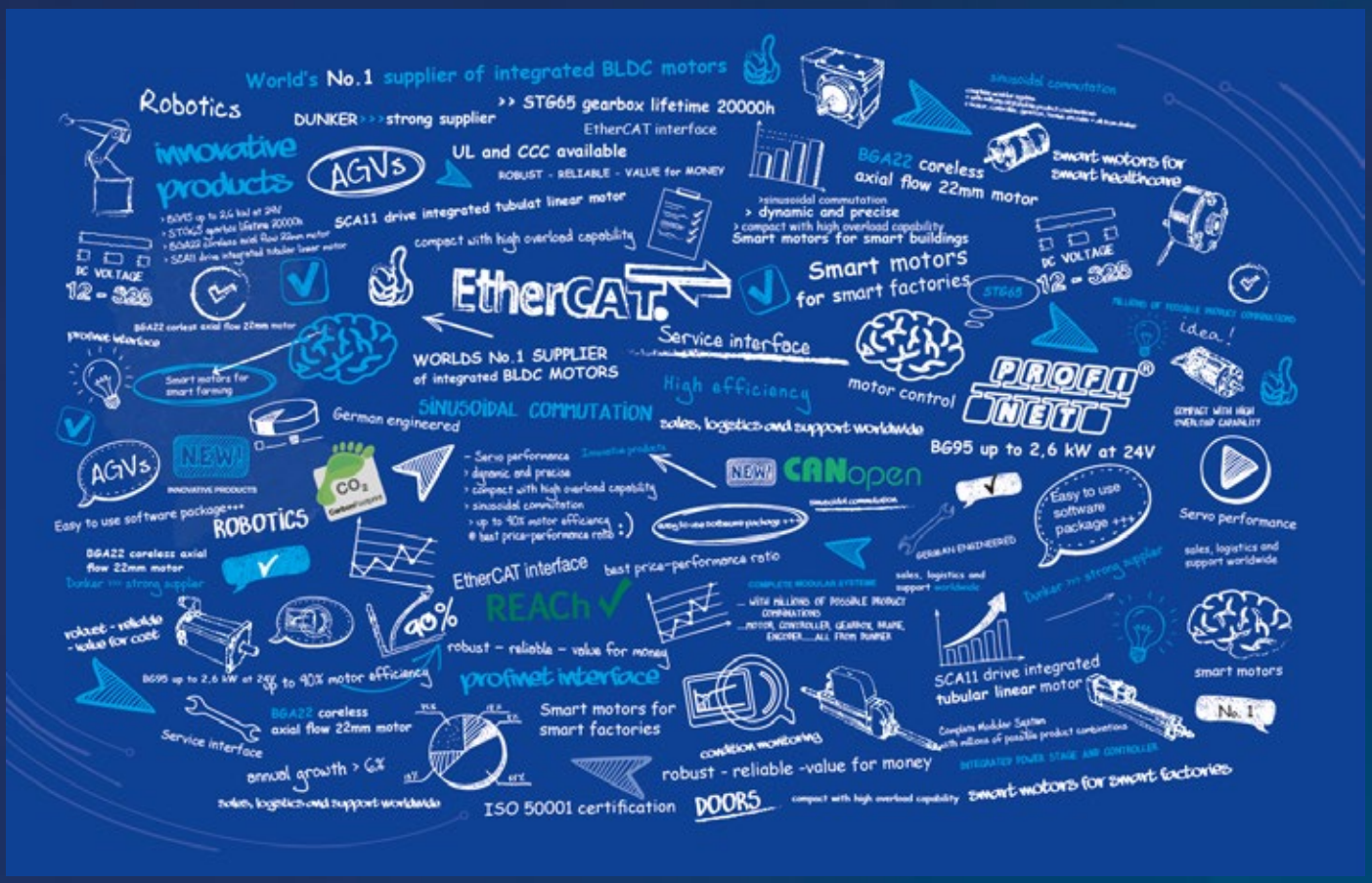
Whitepaper

What‘s exactly a servo motor?



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“Dad, where do the babies come from?” Do you know what to answer here? But this is not the only question. The following one can even for specialists be inconvenience: “What’s exactly a Servomotor?” And indeed, there are different definitions what a servomotor exactly is. In this article, we try to outline several terms around the topic servomotor.

The term “Servo” comes from the Latin word “Servus” that means sleeve.[1] “Motor” comes from the Latin “moto”, “I move“.[2] Even if the origin of the term “servo” is unattractive, it seems to fit perfect to a diligent servant that fulfills his tasks unconditionally.
If there were no further requirements, this definition would also include an unregulated belt drive or a simple blower motor. But this is not the case.
In general, a servomotor is understood as a motor with at least one controller or rather a feedback possibility about their rotational or linear position.

Below there is a definition from the literature and the internet:
» Servomotor (drive technology): servo motor, servomotor. A random drive system with good controllability.[3]
» A servomotor is an electric motor that is power-, rotation speed-, and/or position regulated. The motor enables the configuration of predefined currents, rotation speeds and/or rotation angles.[4]

» Defined as a servomotor is a specific kind of electronic motors that allows the regulation of the motor shaft´s angular position, the rotational speed as well as the acceleration. It consists of a motor which is additionally equipped with a sensor for positioning. The determined rotational position of the motor shaft, which is defined by the sensor, is transmitted continuously to a controller that usually is mounted outside the motor. This so-called servo controller regulates the motion of the motor according to one or more adjustable target points – e.g. target angular position of the shaft or set rotation speed – in a control loop.[5]

The so-called “servo” which only describes the model construction servo, and adjusts a predefined rotational position is excluded from the term servomotor in most of the cases.[6]
“Servomotor” therefore does not only describe a specific motor type, but it can also describe motors of several types. Even electrohydraulic or electro-pneumatic motors are partly named servomotors (in contrast to the definition of Wikipedia). For this article, only electronic motors are defined as servomotors.
Very popular as servomotors are permanent magnet synchronous motors, asynchronous motors and brushed direct current motors. But for this motors, there are also several terms that are used differently. Here, it is listed an overview about frequently used terms and their explanations:

AC and DC Servomotors

An AC motor is defined as a motor that operates on supply voltages generated through rectification of an alternating (AC) voltage (single-phase or three-phase). This are usually direct currents from around 230 VDC up to 600 VDC. In contrast to this definition, DC motors are defined as servomotors that can operate directly on low-voltages up to 48 VDC.[7] A statement about the motor type based on this classification is not possible. According this definition, permanent magnet servomotors are used as AC as well as DC synchronous motors. Asynchronous as well as reluctance motors are primary used as AC servomotors. Permanent magnet- or separately excited brushed direct current motors are used as DC servomotors.[8] Even if it does not seem to be useful in the first moment, the market also provides stepper motors that enable a position feedback and therefore can be offered as DC servomotors.

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Date: 01.12.2018

BLDC and EC Servomotors

From a technical point of view, BLDC (Brushless Direct Current) and EC (Electrically Commutated) servomotors are permanent magnet servomotors. These terms are still connected with small, block-commutated motors that operates in low-voltage ranges. Nowadays, the BLDC labelled EC motors are mostly driven field-oriented, so that they provide the same standards as the “AC-Servo” in terms of dynamics, noise characteristics and energy efficiency.

Figure 1: BLDC motor BG 75 EC with PLG 75

Servomotors, Servo Amplifiers and Servo Drives

Many motors offered as servomotors cannot rotate on their own because there is no integrated servo amplifier. Only servomotors with integrated servo amplifier can regulate their torque, rotational speed or position without external components after connecting to a supply voltage in servo operation. This works via a bus interface or via digital or analogue inputs.
In common usage, it is generally accepted that motors which need an external servo amplifier are also named as servomotors. Those still represent the biggest part of the servomotors. The combination of motor and amplifier is labelled as servo drive.

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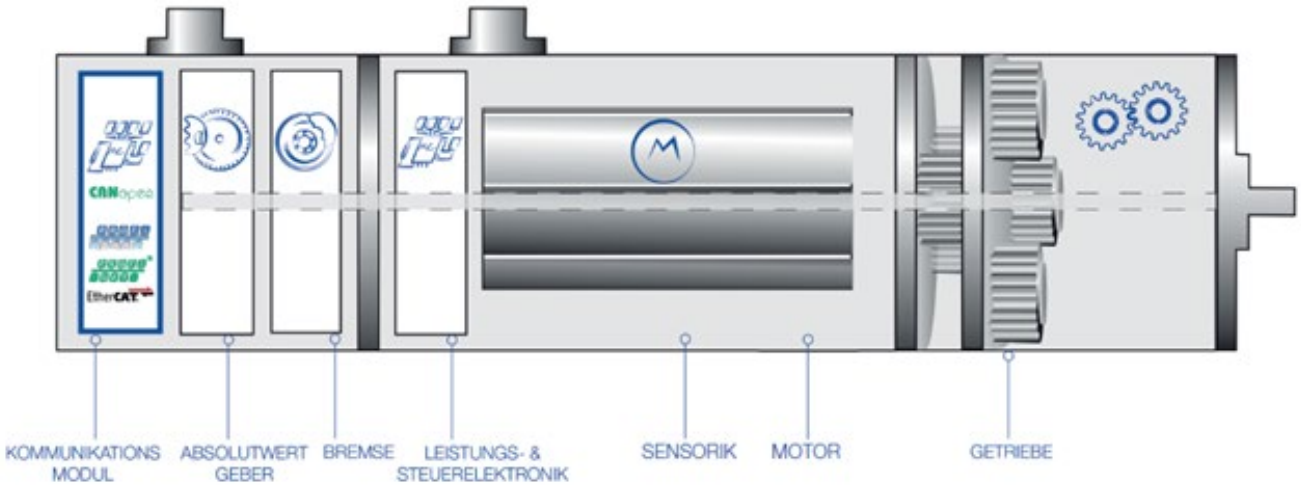

Figure 2: Construction of a Dunkermotoren servo motor

Dynamic

Are all servomotors highly dynamic? Many definitions of servomotors do not discuss that point. But if people think about a servomotor, they expect a highly dynamic drive. Mechanical time constants like – the duration of stops until 63% of maximum rotation speed without load – are one to a few milliseconds. A high dynamic is achieved through several factors. Besides a high flux density and a low rotor inertia, the servomotor need to be attuned to the motor winding to be able to operate highly dynamic.

Motor Feedback

For a long time, resolvers were the state of the art for motor feedback systems of servomotors. But with the digitalization, magnetic and visual systems with digital output signals are on the rise. Here, it is important that the feedback system fits to the servo amplifier concerning the robustness, accuracy and interface. Motors with integrated feedback system and servo amplifier have the advantage that the feedback system automatically fits to the controller.
Now you can at least answer the question what exactly a servomotor is. The question with the babies will you solve on yourself. With this in mind: “Servus!”

As leading manufacturer of motor technology, Dunkermotoren develops and produces with around 1.200 employees high-end linear and rotative drive systems. The company with its headquarter in Bonndorf in the Black Forest presents itself as global partner for solutions around the electric drive technology. Due to the modular system with drive components up to 1100 Watts continuous output power and the integration of logic and power electronics with different field bus interfaces, Dunkermotoren offers their customers a high flexibility. The company is global leader of integrated, smart BLDC servo drives.

Sources:

[1] Begriff Servo:
„Servo“. In: Wikipedia, Die freie Enzyklopädie. Bearbeitungsstand: 14. März 2017, 11:14 UTC. URL: https://de.wikipedia.org/w/index.php?title=Servo&oldid=163571113 (Abgerufen: 26. Mai 2017)

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Date: 01.12.2018

[2] Begriff Motor:
„motor”. In: Wiktionary, The Free Dictionary. Bearbeitungsstand 25. Mai 2017, 00:44 UTC. URL: https://en.wiktionary.org/w/index.php?title=motor&oldid=44257611 (Abgerufen: 26. Mai 2017)

[3] Wagner, Markus: Technisches Wörterbuch Mechatronik/ Automation deutsch-englisch [CD-ROM], Seligenstadt: Lehrmittel-Wagner, 2011

[4] Gerke, Wolfgang: Elektrische Maschinen und Aktoren: Eine anwendungsorientierte Einführung, München: Oldenbourg Wissenschaftsverlag GmbH, 2012, S. 10

[5] „Servomotor“. In: Wikipedia, Die freie Enzyklopädie. Bearbeitungsstand: 7. März 2017, 07:39 UTC. URL: https://de.wikipedia.org/w/index.php?title=Servomotor&oldid=163347715 (Abgerufen: 26. Mai 2017)

[6] „Servomechanism”. In: Wikipedia, The Free Encyclopedia. Bearbeitungsstand: 22. März 2017, 19:07 UTC. URL: https://en.wikipedia.org/w/index.php?title=Servomechanism&oldid=771646856 (Abgerufen: 26. Mai 2017)

[7)] Tobin, Stephen M., DC Servos: Application and Design with MATLAB®, Boca Raton: CRC Press, 2010, S. 18

[8] Firoozian, Riazollah: Servo Motors and Industrial Control Therory, Berlin: Springer Science & Business Media, 2008, S. 60

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