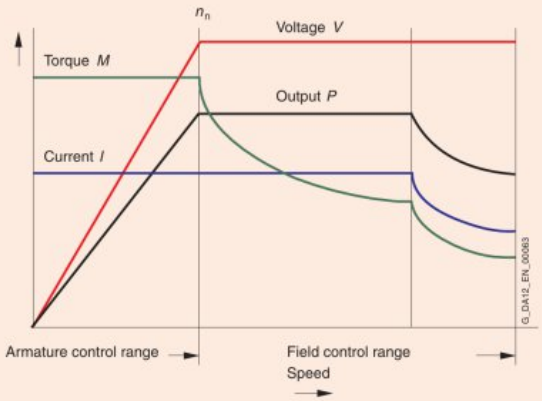
Electrical data

Speed and speed control

DC motors are operated within the armature control range until they reach the rated speed n_N. In this case the motor speed n is approximately proportional to the armature voltage *V*. Furthermore the machine can be operated by field weakening, i.e. by reducing the field current to the maximum field weakening speed n_{Fmax}, respectively to the mechanic speed limit n_{mech}.

The speed-output diagram shows the relation between Voltage *V*, Current *I*, Output *P*, Torque *M* and Speed *n*.



n_N Rated speed
n_{Fmax} Max. field weakening speed at P_N = constant
n_{mech} Max. permissible operating speed

Speed-output diagram for DC motors

Armature control range

The DC motors listed in Catalog DA 12 · 2008 can be operated continuously in the armature control range at constant torque down to a speed of 10 rpm. A static load is only possible for a limited period of time or with a reduced torque.

Field control range

The motor speed can be controlled above the rated speed using field weakening

- with constant armature voltage and output up to the field weakening speeds n_{Fmax} specified in Catalog DA 12 · 2008, section 3 "Selection and Ordering".
- above n_{Fmax} up to the maximum operating speed n_{mech} with reduced output P_{red} as follows:

$$P_{red} = \frac{\frac{n^*}{n_F} - 1}{\frac{n^*}{n_{Fmax}} - 1} \cdot P_N$$

The formula can be rewritten as follows if n_F is required:

$$n_F = \frac{n^*}{\left(\frac{n^*}{n_{Fmax}} - 1\right)\frac{P_{red}}{P_N} + 1}$$

n^* Ficticious reference value with the dimension of speed from the table below

n_F Required field weakening speed in the range $n_{Fmax} < n_F \leq n_{mech}$

Speeds n^* (ficticious reference values only):

Motors, frame size	Speed n^* RPM	Motors, frame size	Speed n^* RPM
160	14400	355	6400
180	13000	400	5700
200	11700	450	4950
225	10500	500	4580
250	9400	630	3580
280	8300		

Noise can increase in the speed range from n_{Fmax} to n_{mech} (further details are available on request).

For uncompensated motors, field weakening ranges exceeding 1:1.2 are only permissible if stable operation is ensured using speed control. Motors which are not controlled must be equipped with a stabilizing series winding to ensure stable operation (please inquire).

Speed increase by field weakening is also possible from any speed within the armature control range. The ratio for loading with the rated current must be

Field weakening speed / Speed at full field ≤ n_{Fmax}/n_N.

Speed specifications on the rating plate

When ordering, the field weakening speed is specified on the rating plate as shown in the following table.

Design		Field weakening speed n_F RPM
Standard design		$1.15 \cdot n_N$ however max. n_{Fmax}
Extended field weakening range for an additional price, with short code	**C05**	$>1.15 \cdot n_N$ to $1.7 \cdot n_N$ however max. n_{Fmax}
	C06	$> 1.7 \cdot n_N = n_{Fmax}$

n_{Fmax} in accordance with Catalog DA 12 · 2008, section 3 "Selection and Ordering"

Short code **C05** and **C06** according to Catalog DA 12 · 2008, section 3 "Selection and Ordering – Options"

If the motor speeds deviate from the specifications in Catalog DA 12 · 2008, section 3 "Selection and Ordering", e.g. as a result of

- speed adaption using armature voltage change and/or field weakening
- further defined permissible field weakening speeds (without short code or with short codes **C05** and **C06**) which are not available for standard versions

the short code **Y80** (non-standard rating plate data) and plain text will also be required when ordering (refer to Catalog DA 12 · 2008, section 3 "Selection and Ordering – Options").

Direction of rotation

Motors are designed for both clockwise and counter-clockwise directions of rotation or reversing operation. When ordering, it is only necessary to specify the direction of rotation for motors of frame sizes 500 and 630 (counter-clockwise rotation: **K98**, or both directions of rotation: **K99**).

Output and overload capacity

The rated outputs specified in the selection tables refer to continuous running duty S1 in accordance with DIN EN 60034-1 for converter operation using the rated armature voltage, the assigned converter connections and supply voltages (refer to section "Supply, converter connection, armature voltage and smoothing reactor", page 9).

The permissible output and the associated speed for other operating conditions can be seen in diagrams on page 13.

Overloading of the motors is possible in accordance with the following table.

Duration, min.	Overload capacity for uncompensated motors		Overload capacity for compensated motors	
	Torque [1] M_{max}/M_N	Current [1] I_{max}/I_N	Torque [1] M_{max}/M_N	Current [1] I_{max}/I_N
15 s	1.6	~1.85	1.8	~1.85
5 s	1.8	~2.2	2.1	~2.2

In the event of frequent overloading, it is assumed that the effective load of the motor does not exceed the rated load.

Dynamic overload limits without taking thermal stress into consideration:

Type	Frame size	Uncompensated motors		Compensated motors	
		Torque [1] M_{max}/M_N	Current [1] I_{max}/I_N	Torque [1] M_{max}/M_N	Current [1] I_{max}/I_N
1G.6/1H.6	**160 ... 280**	1.8	~2.2	–	–
1G.7/1H.7	**355 ... 450**	–	–	2.2	2.3
1G.5/1H.5	**500 ... 630**	–	–	2.2	2.3

[1] with reference to P_N and n_N