Control modes of electrical machines

IEC 60034-1
DIN EN 60034-1 (VDE 0530 Part 1)

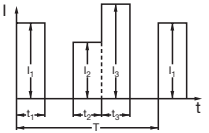
Control mode	Designation/Example
Continuous operation	S1
Short-time operation	S2 60 min
Periodic intermittent operation	S3 35%
Periodic intermittent operation with influence of starting cycle	S4 35% J_M = 0.25 kgm^2 J_{ext} = 0.9 kgm^2
Periodic intermittent operation with electrical braking	S5 35% J_M = 0.25 kgm^2 J_{ext} = 0.9 kgm^2
Uninterrupted periodic operation	S6 35%
Uninterrupted periodic operation with electrical braking	S7 J_M = 0.25 kgm^2 J_{ext} = 3.5 kgm^2
Uninterrupted periodic operation with load/speed variation	S8 J_M = 0.25 kgm^2 J_{ext} = 3.5 kgm^2 10 kW 25% 20 kW 30% 15 kW 45%
Operation with non-periodic load and speed variation	S9 additional entry for reference load
Operation with individual constant loads	S10 $p/\Delta t$ = 1.3/0.5, 1/0.4, 0.8/0.3, r/0.2, TL = 0.7

J_M Moment of inertia of motor
J_{ext} Moment of inertia of load
$J_{r.m.s.}$ Motor r.m.s. current

For load cycles the duration of which is relatively short compared with the thermal time constant of the machine, simplified formulas may be entered.

a) r.m.s. motor load

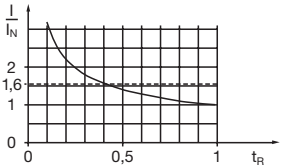
$$I_{r.m.s.} = \sqrt{\frac{I_1^2 t_1 + I_2^2 t_2 + \ldots + I_n^2 t_n}{T}}$$



$$I_{r.m.s.} = I_r \cdot \sqrt{\left(\frac{M}{M_r}\right)^2 \cdot \cos^2\varphi + 1 - \cos^2\varphi)}$$

b) In control mode S3, the motor current which can be supplied I may be higher than the rated current I_r.

$$I = \frac{Ir}{\sqrt{\frac{t}{T}}} = \frac{Ir}{\sqrt{t_R}}$$



At $P/P_r > 1.6$, please consult the manufacturer.

t_R = Relative duty time

How operating frequency affects the ratings of asynchronous motors

f [Hz]	$\frac{P}{P_r}$ [%]	$\frac{n}{n_r}$ [%]	$\frac{M}{M_r}$ [%]
50	100	100	100
60	100	120	83

How the coolant temperature T_c affects rated power

T_c [°C]	40	45	50	55	60
$\frac{P}{P_r}$ [%]	100	95	90	85	80

How the installation height h affects the rated power

h [m above sea level]	1000	2000	3000	4000	5000
$\frac{P}{P_r}$ [%]	100	95	90	85	80