Short-term operation (S2)
In short-term operation, a brief peak load is followed by a long pause during which the drive can cool down to the ambient temperature. During the load cycle, only those drive elements heat up that have a correspondingly short thermal time constant.

Intermittent operation, ON-OFF operation (S3)
Classic ON-OFF operation is characterized by a cycle that lasts t_{on} with a hypothetically constant torque load M_{on} and is followed by a currentless period lasting t_{off} before the cycle is repeated constantly. This load profile can be used as a simplified description of frequent start-stop processes. The effective active load is

$$M_{eff} = \sqrt{\frac{t_{on}}{t_{on} + t_{off}}} \cdot M_{on} \quad \text{or} \quad I_{eff} = \sqrt{\frac{t_{on}}{t_{on} + t_{off}}} \cdot I_{on}.$$

On known drives, the maximum permissible continuous load current I_N (rated current) describes the maximum permissible load. Provided that the duty cycle t_{on} is short in comparison to the shortest thermal time constant, several maximum load values can be derived from the condition that the effective value of the current must be less than I_N.

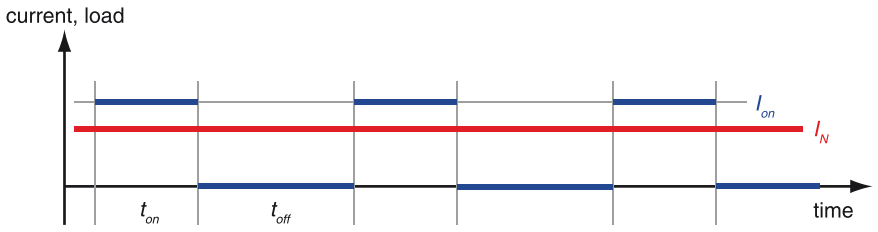

Figure 4.9: Curve of the load during ON-off operation. The current during the ON phase I_{on} may be greater than the continuous load current I_N (red line).

How long may the ON period t_{on} last?
The duration of the ON period depends on the magnitude of the overload, i.e. on the ratio of I_{on} to I_N, and on the duration of the pause t_{off} during which the heat can be dissipated. The following relationship applies

$$t_{on} \leq \frac{I_N^2}{I_{on}^2 - I_N^2} \cdot t_{off}.$$

– To prevent excessive temperature fluctuations within the duty cycle and to make it possible to use the averaging method, an additional requirement is that t_{on} may be a maximum of approximately one half of the thermal time constant of the motor winding.
– If $I_{on} < I_N$ there is no overload and t_{on} may be as long as necessary.

How long must the pause t_{off} be?
Analogously, the minimum length of the pause depends on the load and the length of the ON period

$$t_{off} \geq \left(\frac{I_{on}^2}{I_N^2} - 1\right) \cdot t_{on}.$$

How high can the maximum current during the ON period I_{on} be?
For the maximum load with a given duty cycle and rated current (= maximum continuous load current), we get

$$I_{on} \leq \sqrt{\frac{t_{on} + t_{off}}{t_{on}}} \cdot I_N = \sqrt{\frac{t_{tot}}{t_{on}}} \cdot I_N.$$