Option (chargeable)
TorqueProfile

(available for all SLS and SLR)

Contents

1 Introduction

In many application it is desired to limit phase current (=torque) as a function of speed (e.g. limit power by folding back torque with increasing speed).

Option TorqueProfile offers this function in a very flexible way:

Phase current can be limited both in motoric and generatoric operation separately. Also a maximum and minimum phase current can be applied – both motoric and generatoric.

The TorqueProfile characteristic curves (I_mot_max, I_mot_min, I_gen_max and I_gen_min) can be edited separately specifying step-points [%I, %speed] which will be interpolated linear at runtime.

TorqueProfile setups are managed as an attachment to a normal SignalCurve. Both are stored in a single *.SLP-file.

Important:
Option TorqueProfile only needs to be enabled on SLS/SLR-device to edit a existing TorqueProfile or make new TorqueProfile from scratch.
No Option needs to be enabled on SLS/SLR-devices to execute such TorqueProfile at runtime. Just copy your *.SLP-file with TorqueProfile attachment down to as many SLS/SLR-devices you like. Even display is possible on devices without Option TorqueProfile, but no values can be changed.

2 Access to TorqueProfile

TorqueProfile section can be opened by a klick on the "TorqueProfile"-button within the "SignalCurve → Edit" window.
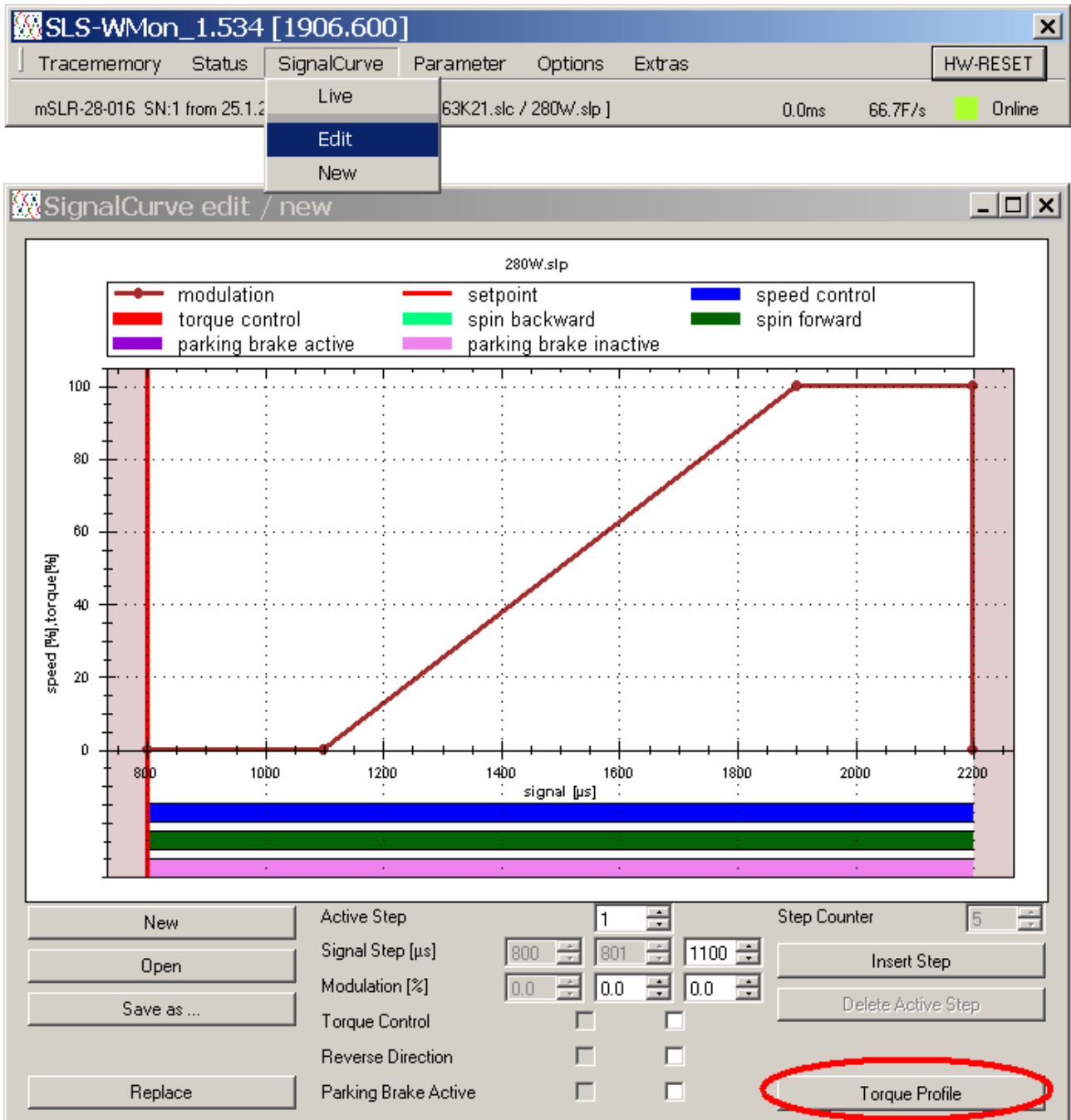
If no TorqueProfile attachment was found and no TorqueProfile-option is enabled, the "TorqueProfile "-button will stay inactive (grayed).

If Option TorqueProfile was enabled on SLS/SLR-device, the settings are displayed and can be modified.
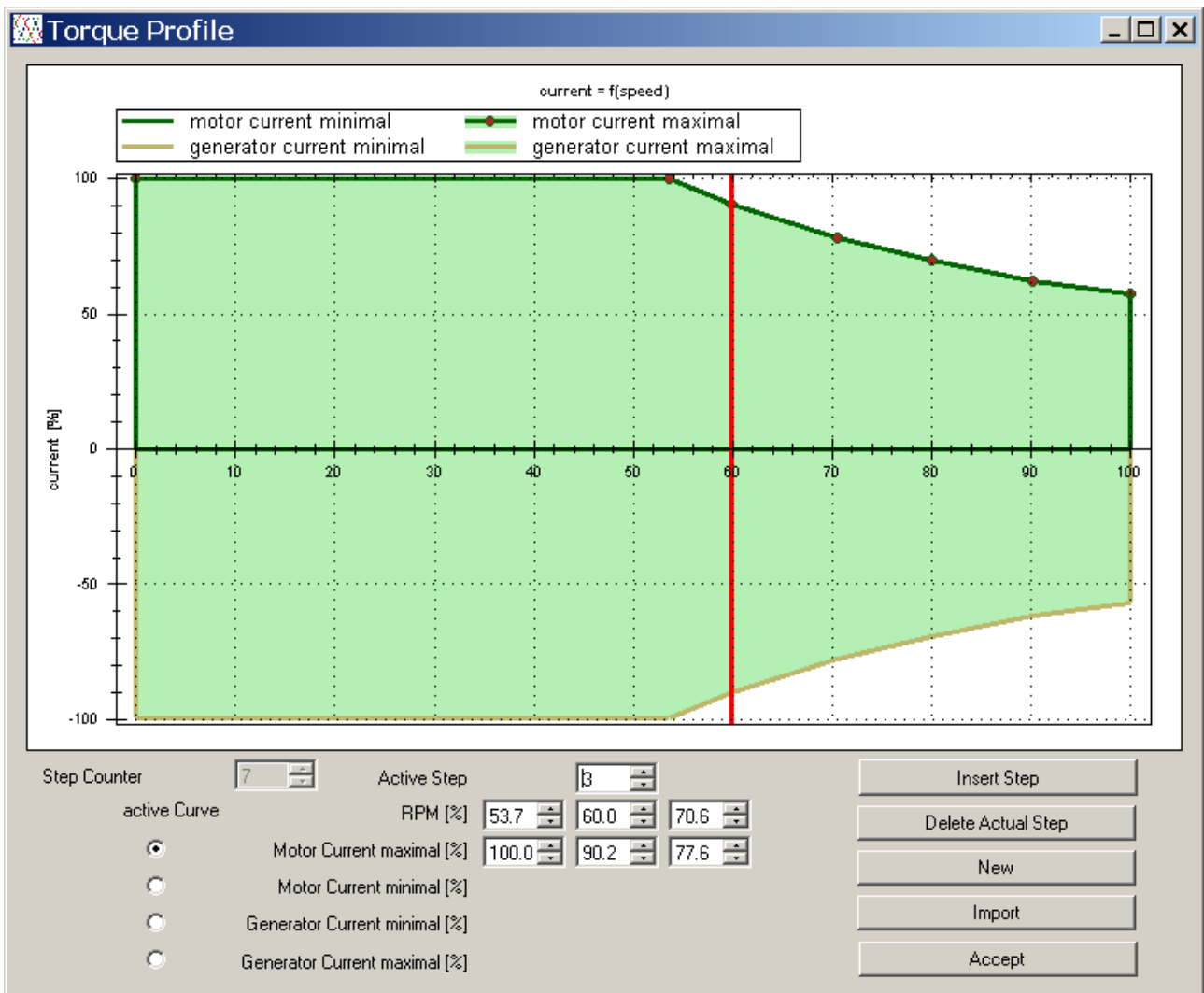
If Option TorqueProfile was not enabled the SLS/SLR-device, the edit function is not available - values can't be modified but watched.

3 Control and edit

All control and edit elements are documented in detail within the User-Manual for the SLS-Windows-Monitor: **Manual_WMon_en.pdf**

4 Examples

4.1 Limit mechanical output-power

Electrical assisted bikes (Pedelec) are limited by law to a max. power of 250W.
This can easily implemented by using TorqueProfile.

First use the track manager to setup a 250W limit (black line with dots) P_mech for a
certain motor setup and export it to a file (e.g. 250W.SLK):
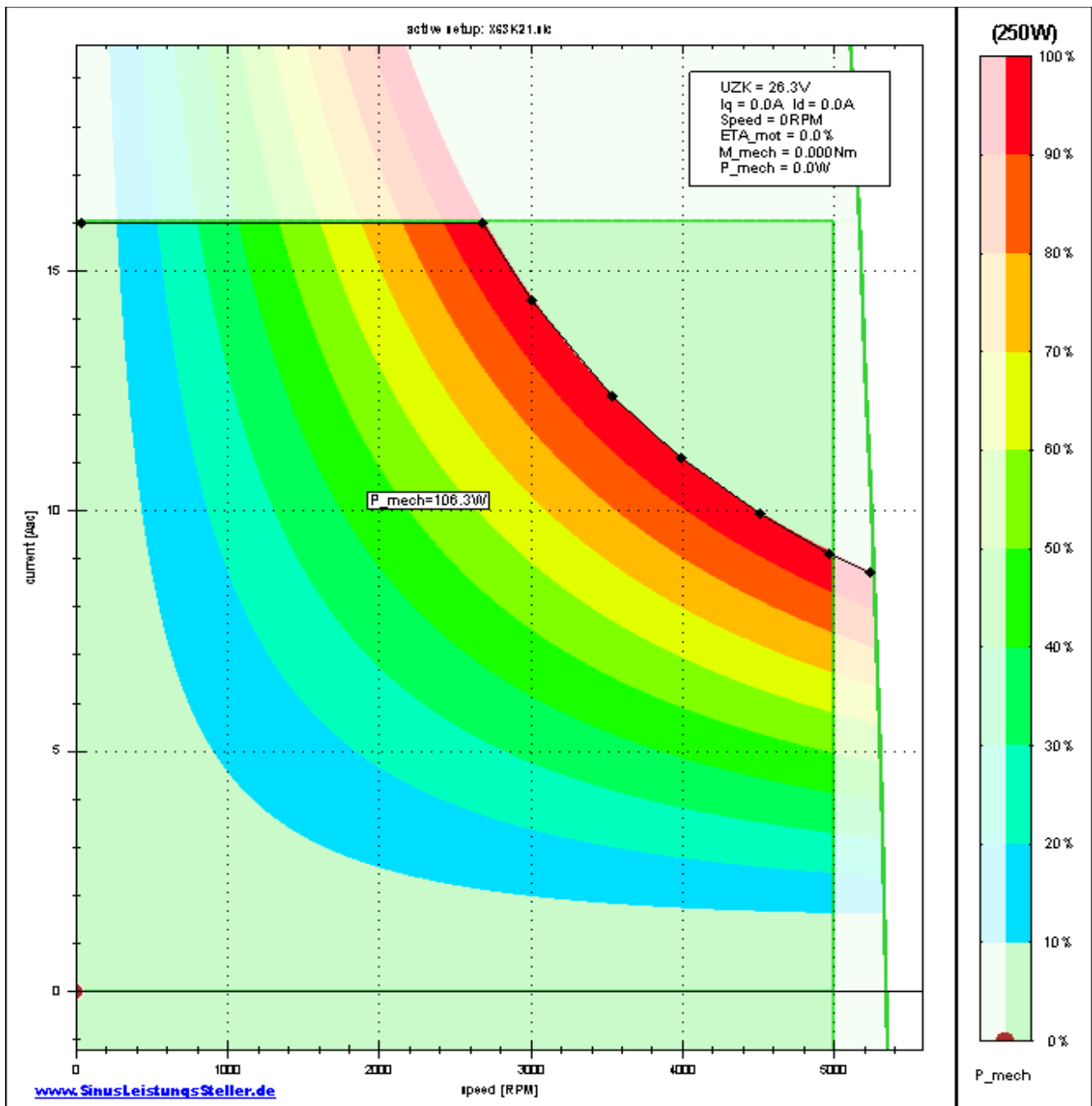
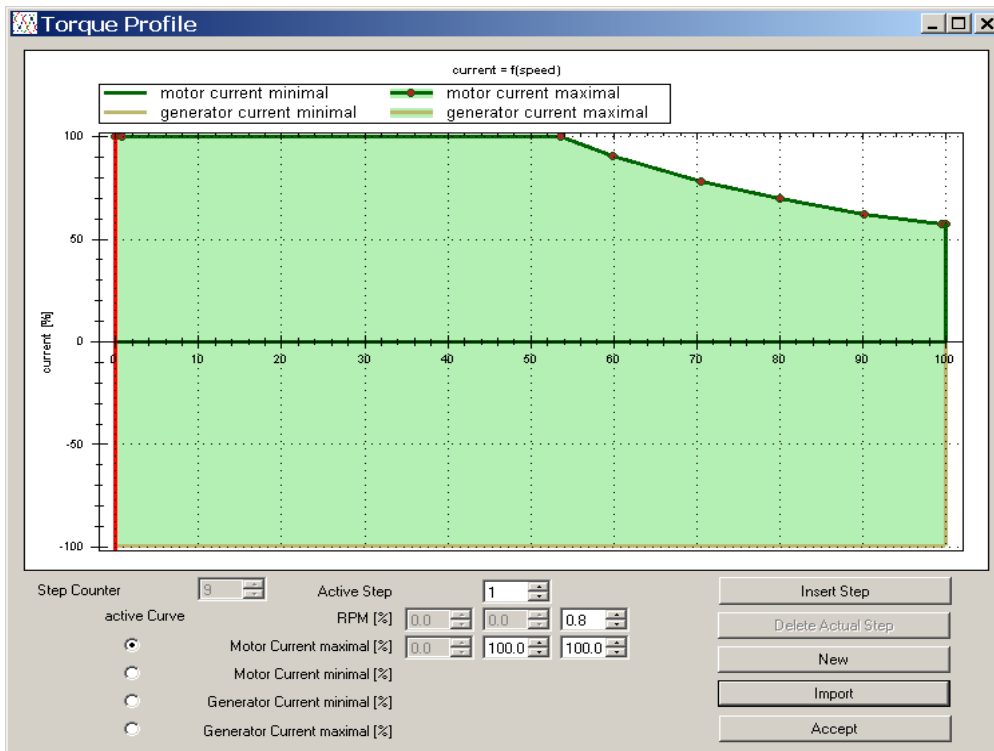
(… another option "ETA_Live" used here to derive P_mech)

Next select the track-file, is imported to the actual selectet curve "Motor Current maximal":
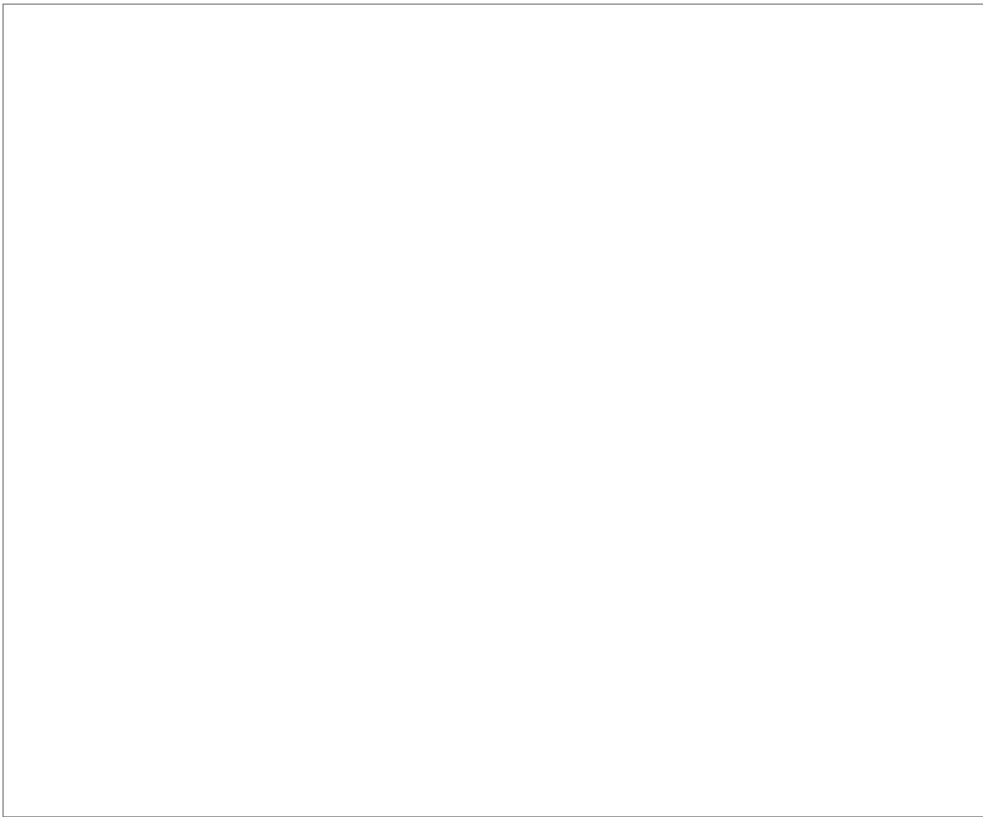
Then this 250W-limit-track is transfered to to the TorqueProfile's I_mot_max curve:

After saving the new *.SLP-file and replacing it on SLS/SLR, the new limits (incl. max. 250W P_mech) in "OperationPointLive" now looks like:
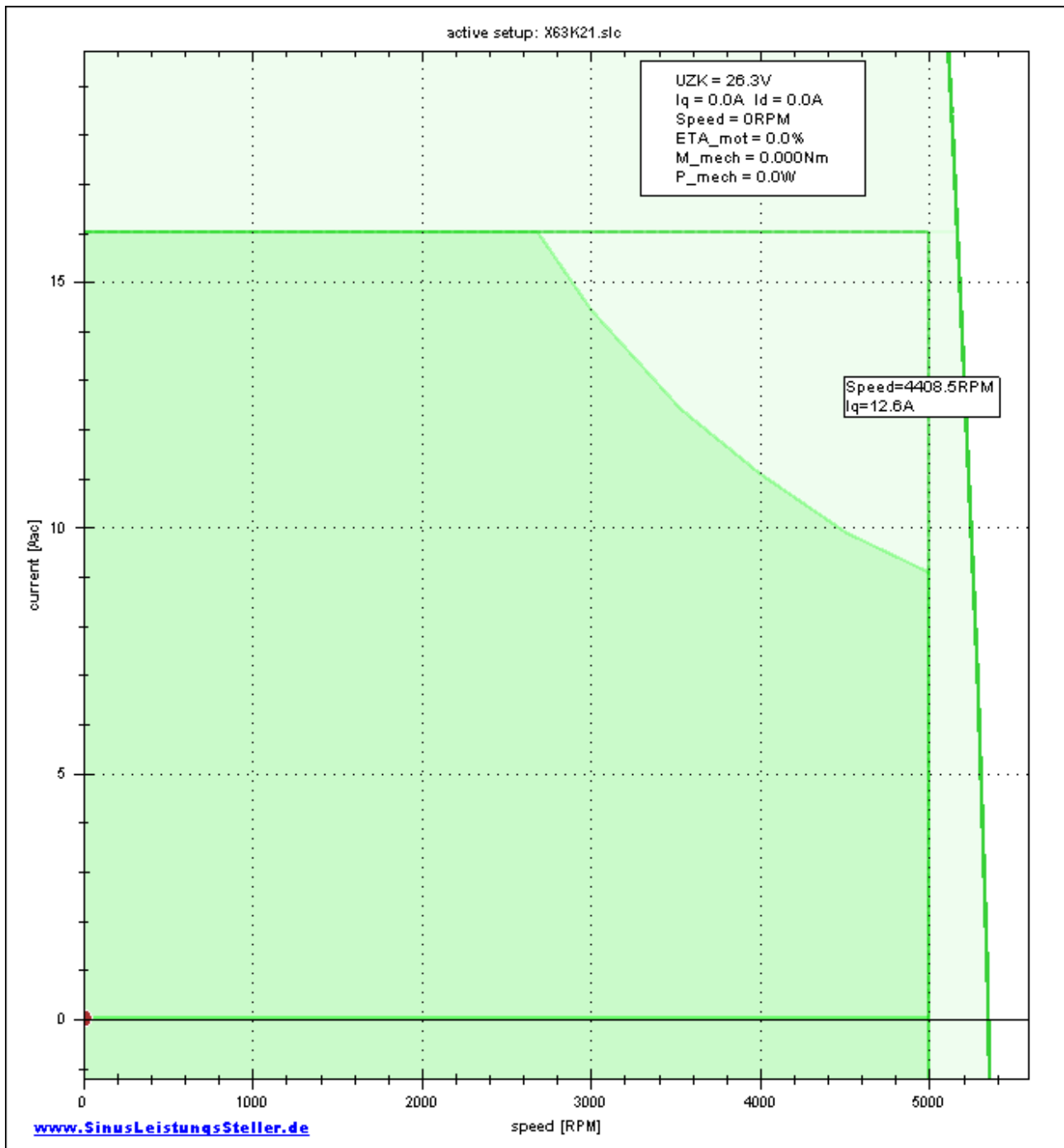
From now, only operation points are allowed with mechanical output power (P_mech) below 250W (darker green area).

Other limits are set by parameter file (5000rpm=100%) or by hardware-limits (16Aac=100% because of mSLR-28-*16* used for this example)

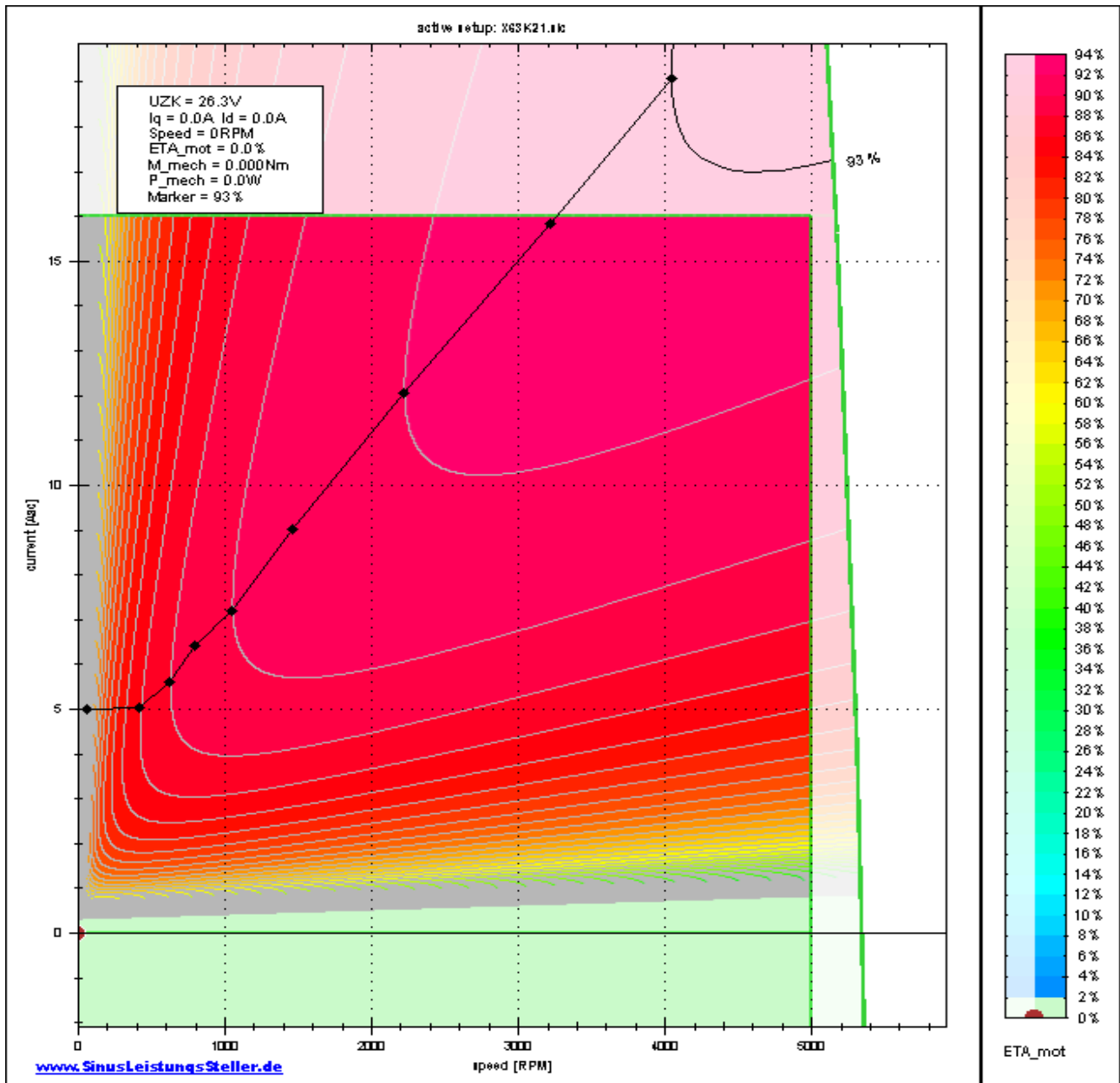## 4.2 Acceleration on path of peak efficiency

Whenever energy is limited, it must be used in economical way (e.g. endurance-competition of solar driven vehicles), it might be an advantage to accelerate along motor´s peak efficiency - instead accelerating with max torque possible.

Lets watch the following ETA-plot of a typical BLDC-motor ...

(… another option "ETA_Live" used here to derive ETA_mot)

… same color in this plot means same efficiency (ETA), separated by "shell"-curves.

The path for best efficient acceleration is found along current values with highest possible ETA for a certain speed. Such points meet with vertical tangents to the shell curves shown in ETA_mot-plot.

The black line combines these points to a track (again using the track-manager). Allowing min current of 5A for a save startup from zero speed.

Working points above this black line will accelerate faster up to same final speed, BUT with less efficiency and so with higher consumption of energy.

… wouldn't it be nice to sort-out these bad working points by default?
If no hill-climbing (low speed with high torque/current) is needed: … YES!

Exporting the track to a file and importing it to CurrenProfile results in:
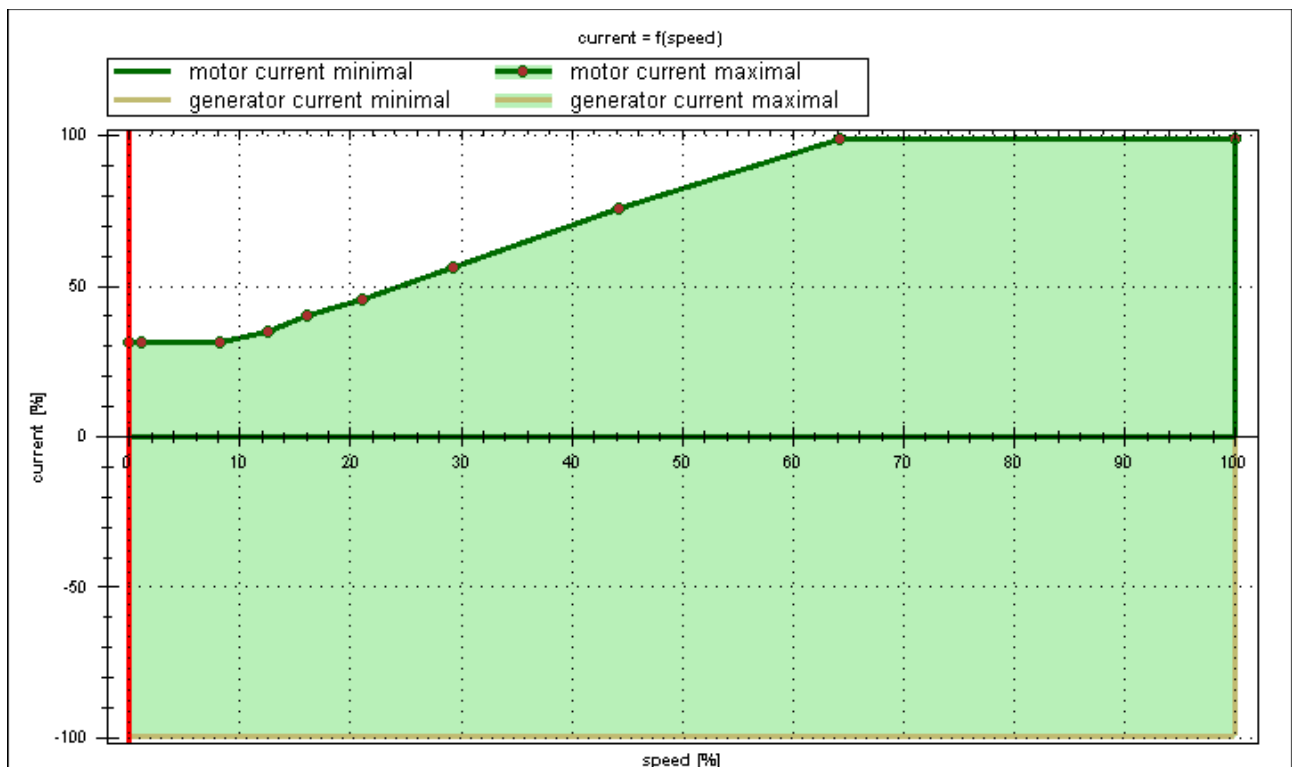
After saving the new *.SLP-file and replacing it on SLS/SLR, the new limits in "ETA_mot"-plot now looks like:
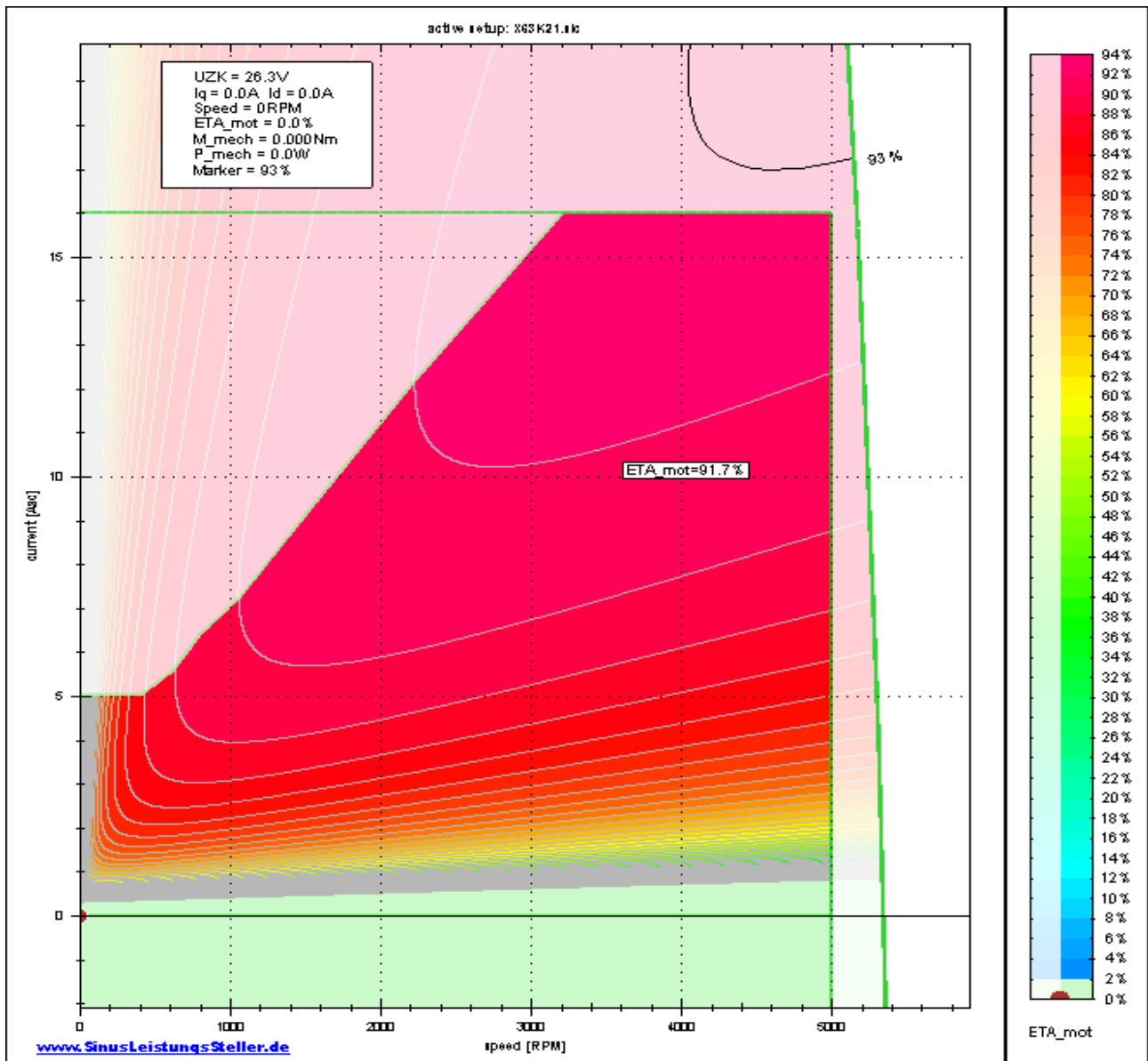
(… another option "ETA-Plot" used here to derive ETA_mot)

Now, acceleration can be performed with "full throttle", knowing it will run at best efficiency, limited by TorqueProfile.

Other limits shown are set by parameter file (5000rpm=100%) or by hardware-limits (16Aac=100% because of mSLR-28-*16* used for this example)

TorqueProfile will perform same way regardless if the signal-curve is configured to run in speed-mode or in torque-mode.

4.3 Propeller-Guarding

Basically torque (and also phase-current) rises N-square with speed N whenever a propeller is used, regardless it runs in air, water or other media. With that knowledge, the possible working points of propellers are well-known.
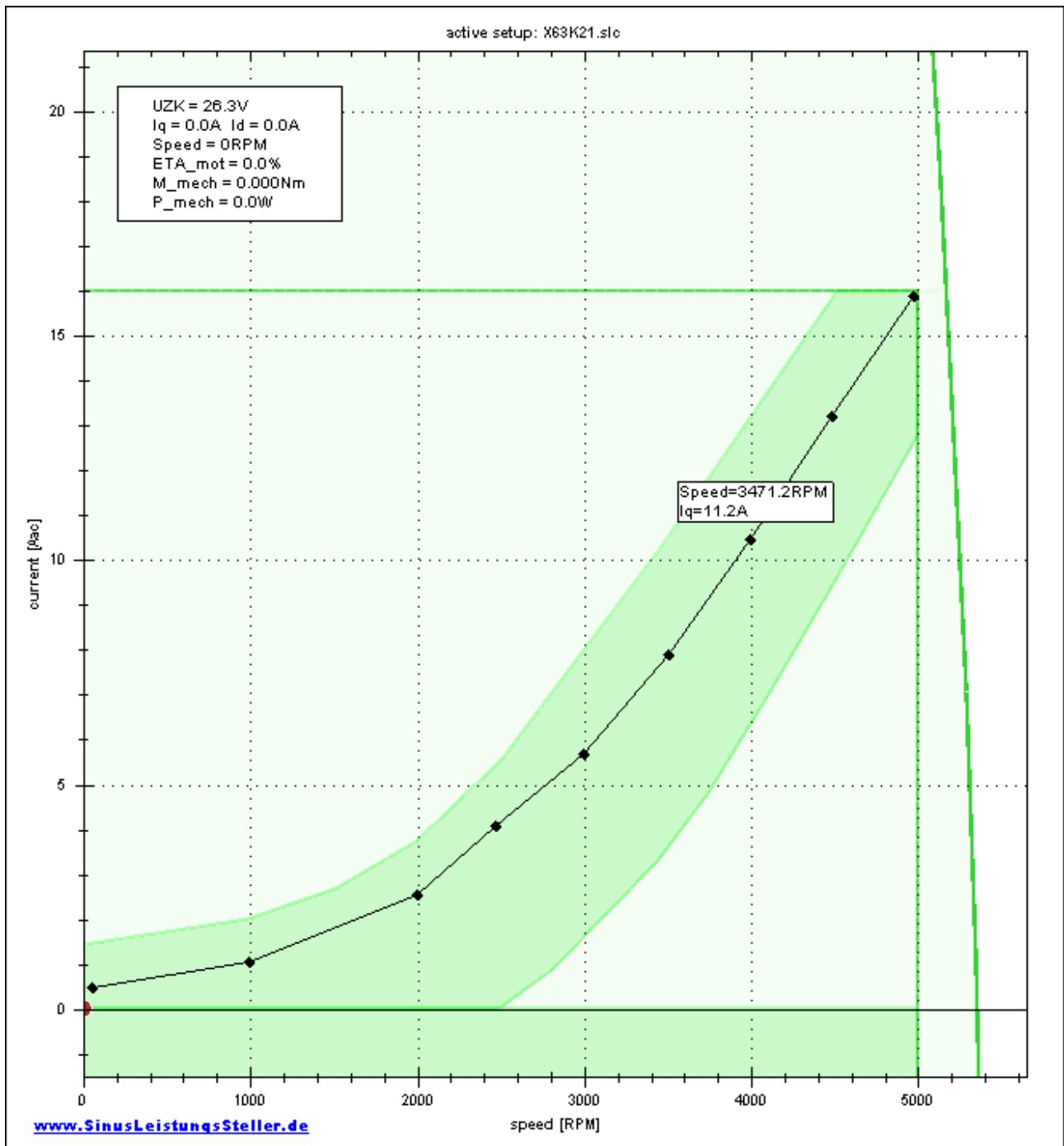
If a propeller-setup suddenly operates outside these range of valid working points (plus some margin), it is very likely that something is going wrong:

– a boat´s propeller could pickup something blocking (e.g. sea-grass, rope, etc.) resulting in much higher torque at certain speed → boat should stop before motor is overloaded

– a boat´s propeller got ground contact and lost one of 3 blades resulting in less torque at certain speed → motor should slow down before damage due to unbalanced propeller-run (bearings, etc.)

– an airplane´s propeller should not start with full possible torque because of safety reasons (people may be near to it but undiscovered...) … a kind of "softstart" with limited power would be much less dangerous!

– an airplane´s propeller got damaged in flight (sucked stone at startrun, bird-strike, etc.) resulting in less torque at certain speed → propeller should slow down, because of unbalanced run (danger for airplane´s structure because of vibration, bearings may also be affected, etc.)

– also propellers in pumps can be guarded in similar ways (e.g. if any kind of blockage or leaky pipe system)

TorqueProfile can support realizing such Propeller-Guarding-System.

Overload situation can be guarded with I_mot_max-TorqueProfile and underload situation can be guarded with I_mot_min-TorqueProfile.

A TorqueProfile setup for Propeller-Guarding in "OperationPointLive" could look like:

active setup: X63K21.slc

UZK = 26.3V
Iq = 0.0A Id = 0.0A
Speed = 0RPM
ETA_mot = 0.0%
M_mech = 0.000Nm
P_mech = 0.0W

current [Aac]

Speed=3471.2RPM
Iq=11.2A

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speed [RPM]

Many other applications with TorqueProfile are possible.

5 Option order

User can order this option together with SLS/SLR device. Then this option will be enabled on your device before shipping.

If you need this option later, it can be enabled via an enable-key. This enable-key will be generated by us (we need type and serial number of your SLS/SLR) and send to you by email.