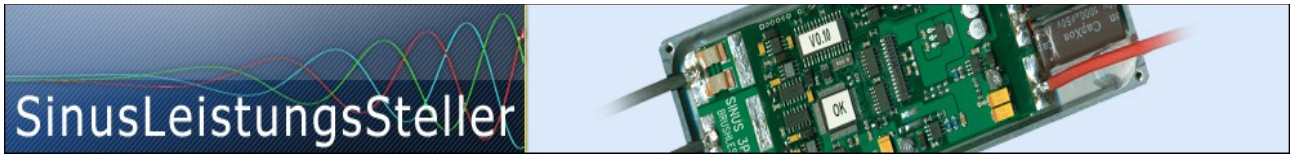
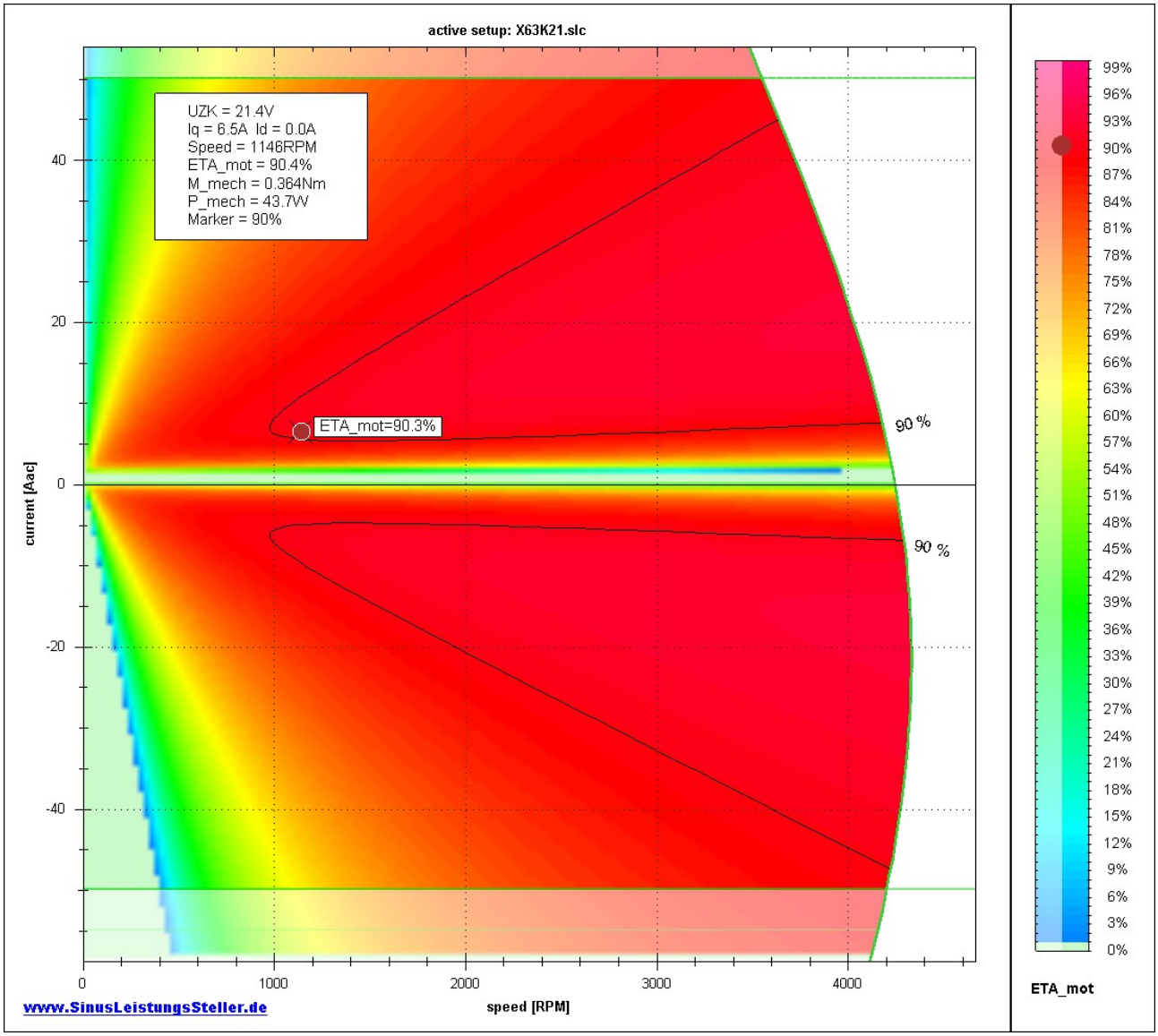


Option (chargeable)

ETA_Live



(only available for SLR)

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Contents

1 Introduction

Option ETA_Live is an functional upgrade to option OperationPoint_Live and only available for SLR-family.

It's massively expanded functionality allows to evaluate the whole drivetrain in all aspects of **efficiency, power and losses.** Comparison of different motors is much easier now. Optimization process can be done effectively and on a a straight way to target.

Option ETA_Live offers a powerful tool to calculate efficiency/losses of motor/ECU/system and also power on input(DC) and output(shaft). User can switch between these layers at any time.

The motor model for internal computing is derived from parameters obtained during the tuning process. The model of ECU/SLR is supplied with it's coefficients from SLR-firmware, considering differences in SLR-hardware-variants (e.g. R_{ds_on} of installed MOSFETs) and run-time changes (e.g. MOSFETs temperature).
A second model ("manually") can be calculated in parallel with modified model-parameters to figure out differences and effects of single model-parameters. This second model is running for motor and ECU.

Taking advantage of high computing power of modern PC, it is possible to display complete couples of motoric and generatoric quadrants simultaneously in **real-time, high resolution and in color**.

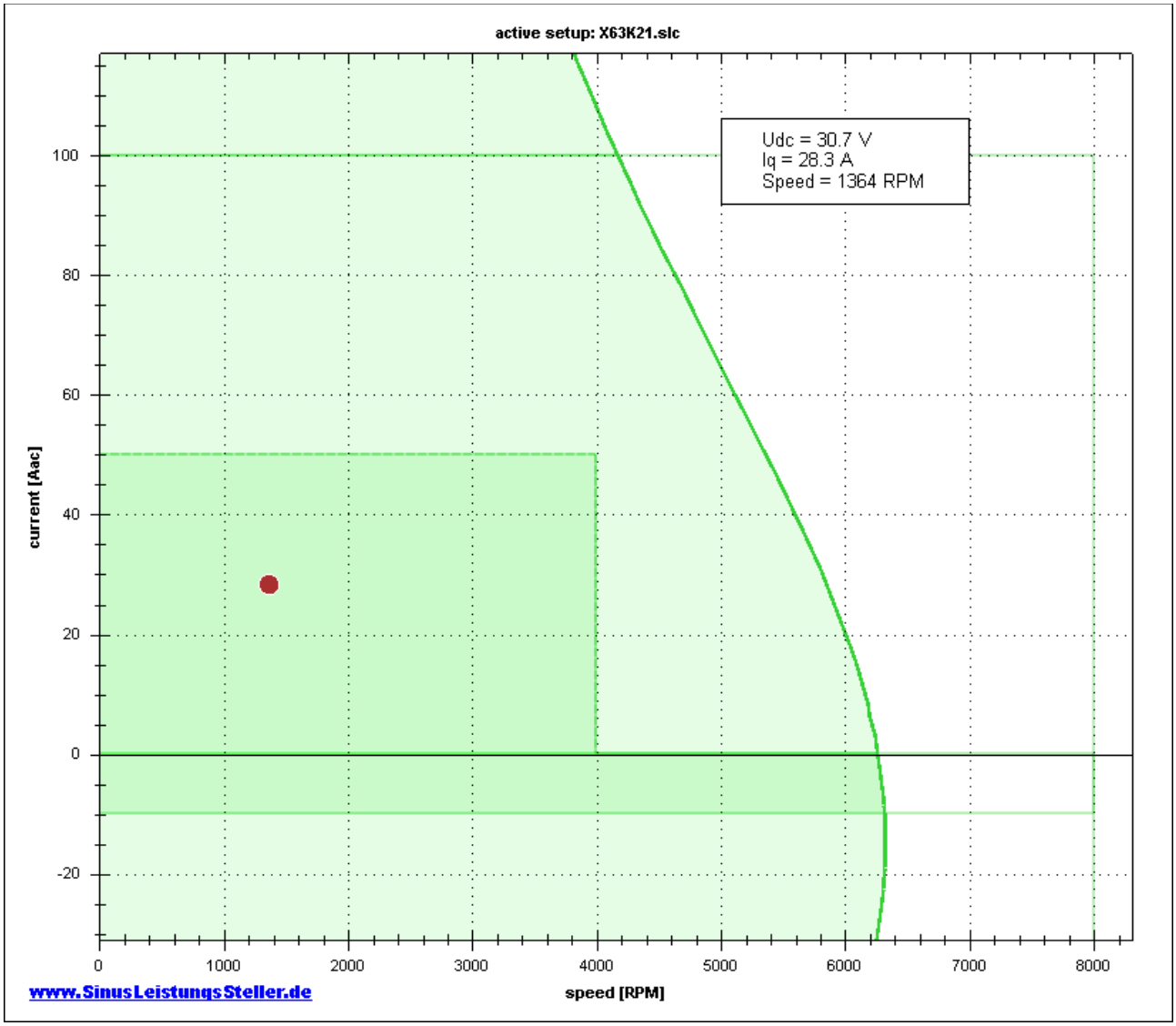
Option ETA_Live offers unique insights and manifold points for investigation and deep understanding a motor drive system.

remember:
This diagram is calculated from motor parameters derived at normal temperature (about 25°C) and without saturation effects. Such non-linear effects are not reflected by the model used for this calculation.

2 Elements - equal to Option OperationPoint_Live

2.1 Actual working point

Introducing an actual working point (small red dot) feeds back, where the motor works actually in respect to the motor limits. It follows changes in real-time.



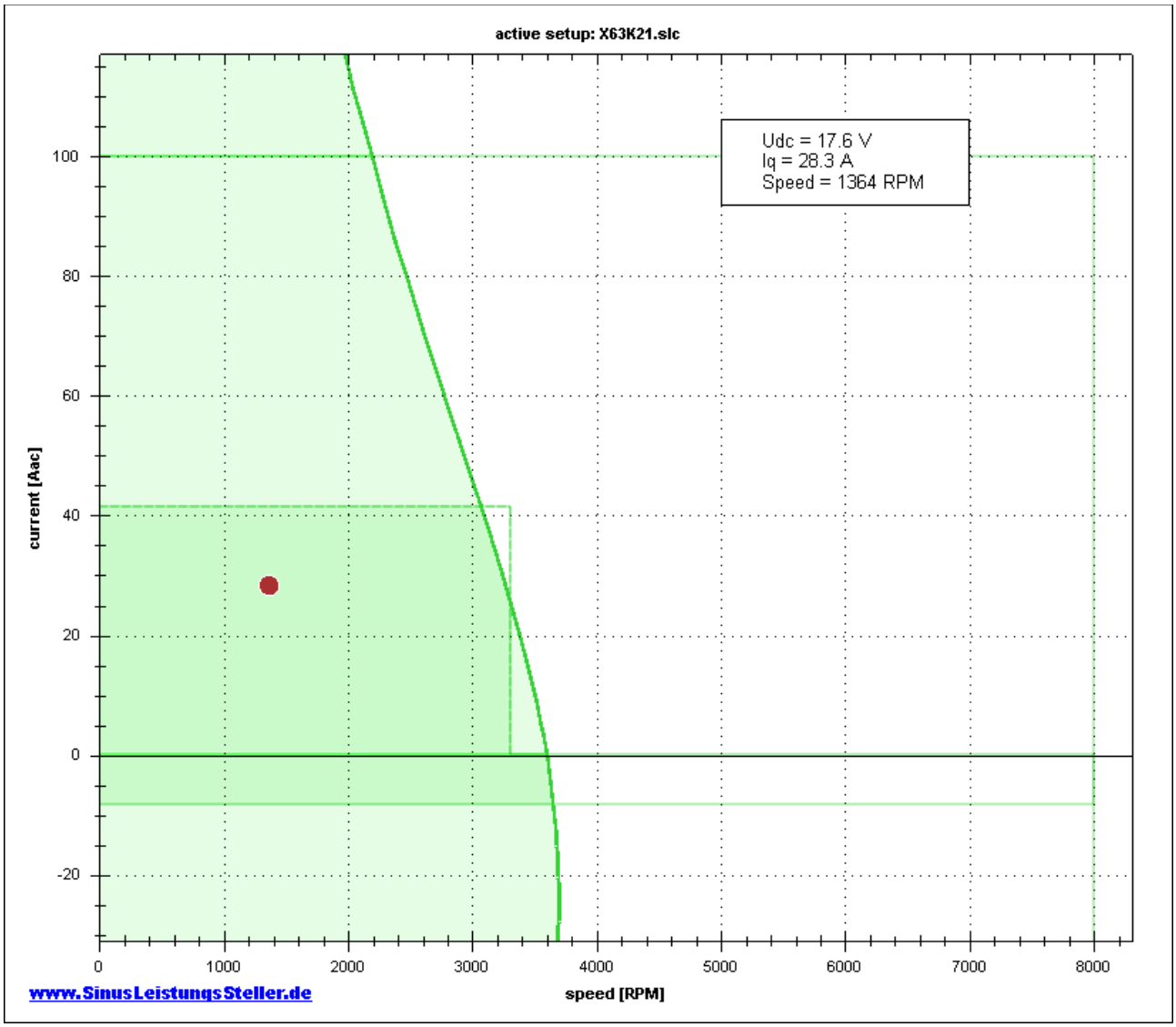
2.2 Controller Limits

The limits set by controller hardware itself and by parameters are shown also in the diagram:

- max motoric current (e.g. hardware-limit +100A, parameter-limit +50A)
- max. generatoric current (e.g. hardware-limit -100A, parameter-limit -10A)
- max speed (shown in pictures: max=8000rpm=100%, set to 4000rpm=50%)

2.3 Derating

If any derating (overtemp, over-/undervoltage, etc.), the limits will be fold back in the diagram real-time.



(Udc_low_lim = 18.0V → derating is active in picture above, limits are folded back)

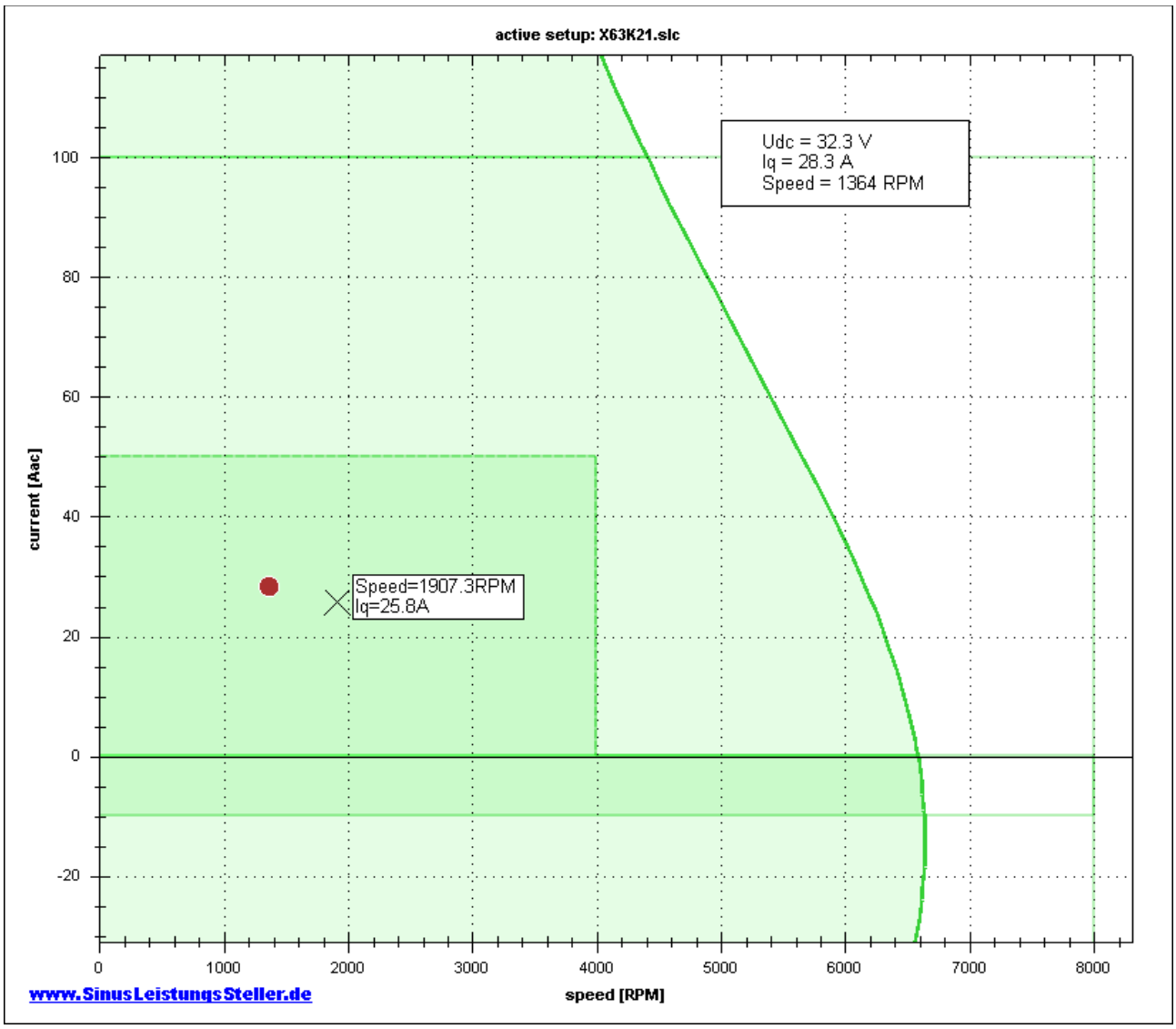
Area within enveloping curve is shown in light green color.
Area within limits is shown in slightly darker green color, thats the range, the motor can actually operate.

2.4 Status

Main status information (Uzk, Iq and speed) is shown numeric in a small status-window. This status-window can be moved (by catching it with the mouse left button) to any position.

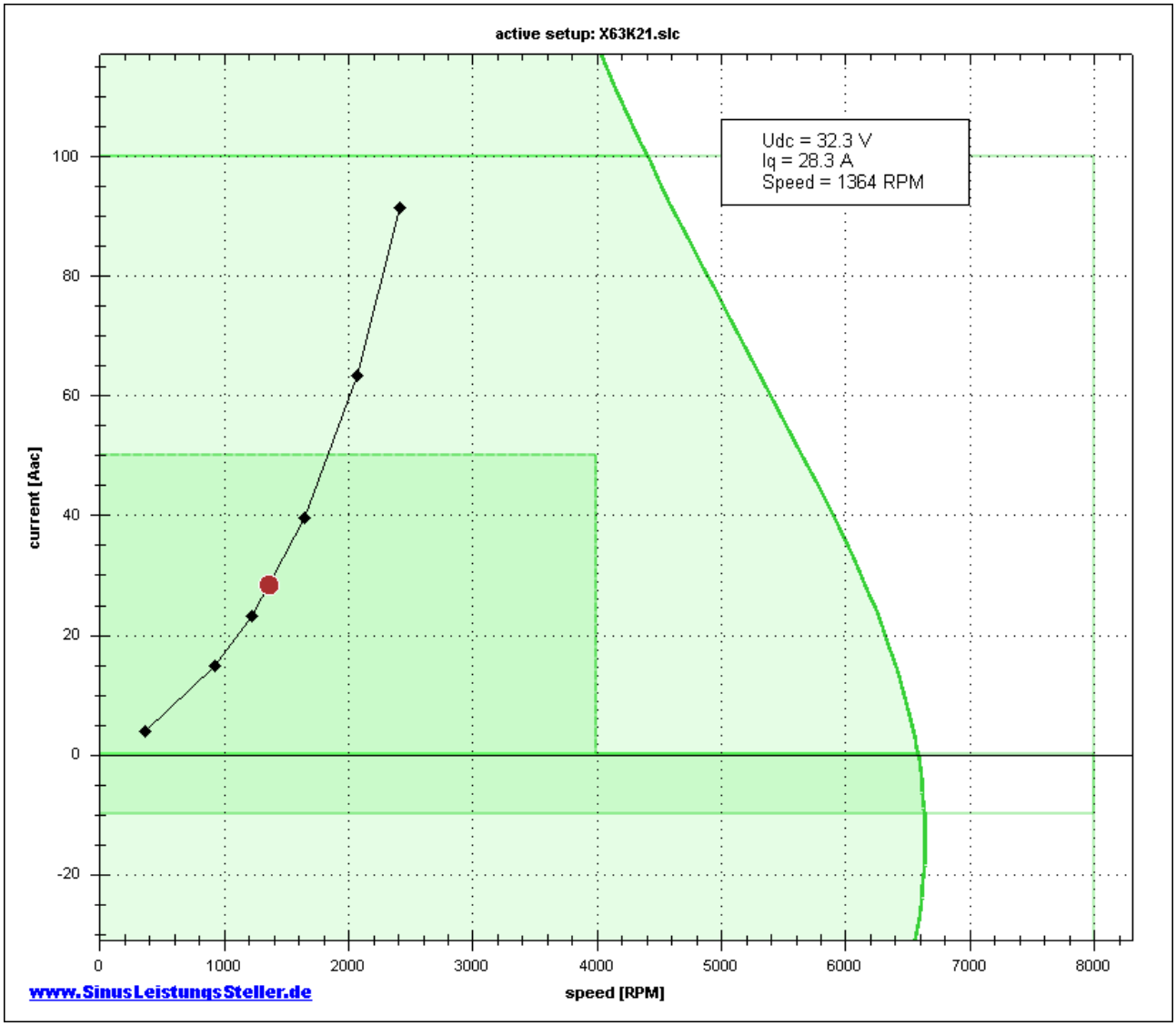
2.5 Cursor

The mouse cursor can be set active (right mouse click menu) to show extra information for its actual position (current, speed). Actual position can be fixed (and released) with the space-bar on your keyboard.



2.6 Track manager

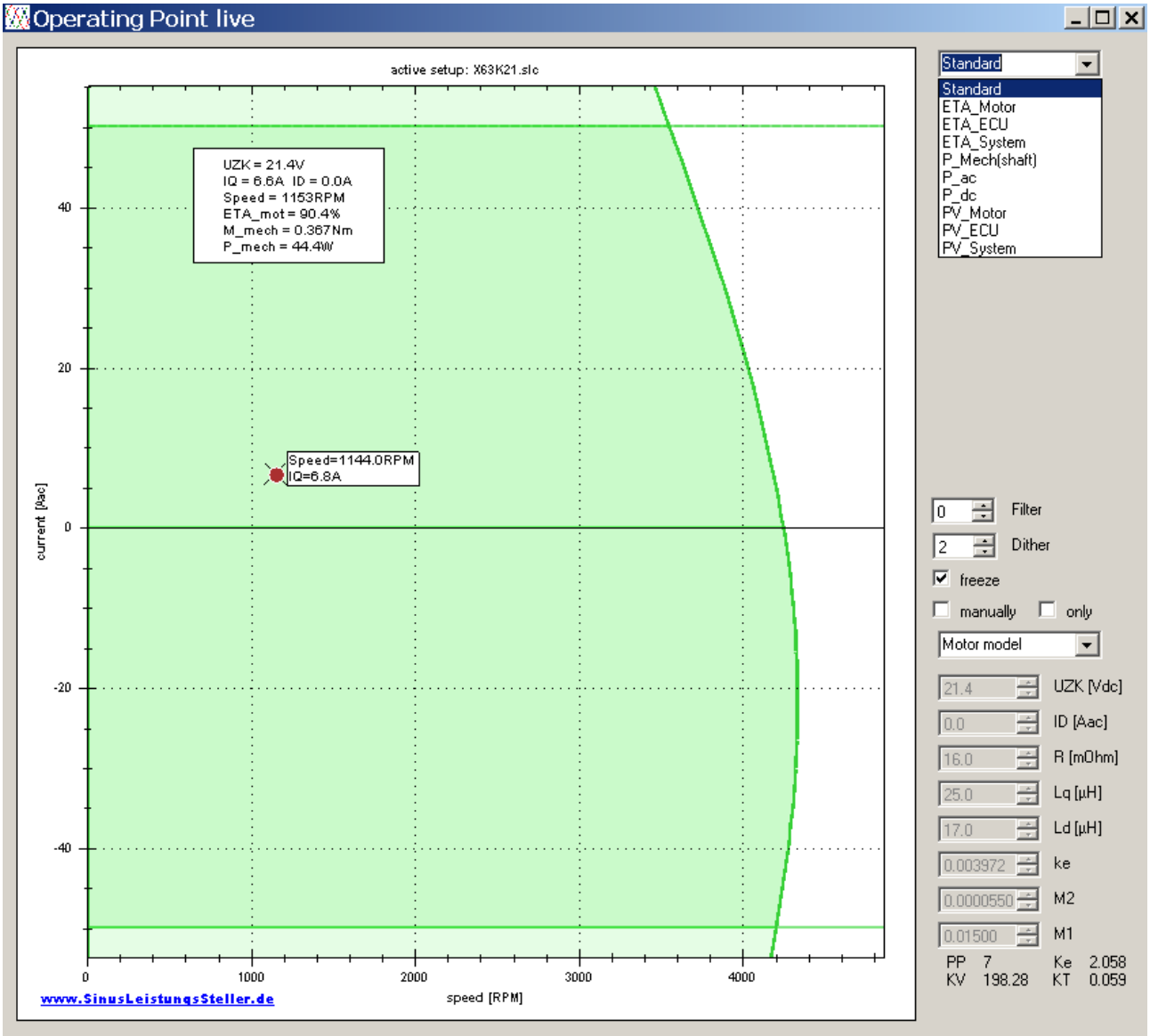
Both, cursor position and actual operation point, can be tracked. Single positions will be combined by lines to record characteristic curve (of e.g. a propeller) as samples of [IQ, speed].
Such propeller characteristic curve can be saved to a file (*.SLK) and re-imported later e.g. to another motor characteristic curve in order to find best matching combination out of a set of propellers and motors. This is a very easy to use and time saving method to find an optimum!



3 Elements - introduced by Option ETA_Live

3.1 Numeric Display and Layer "Standard"

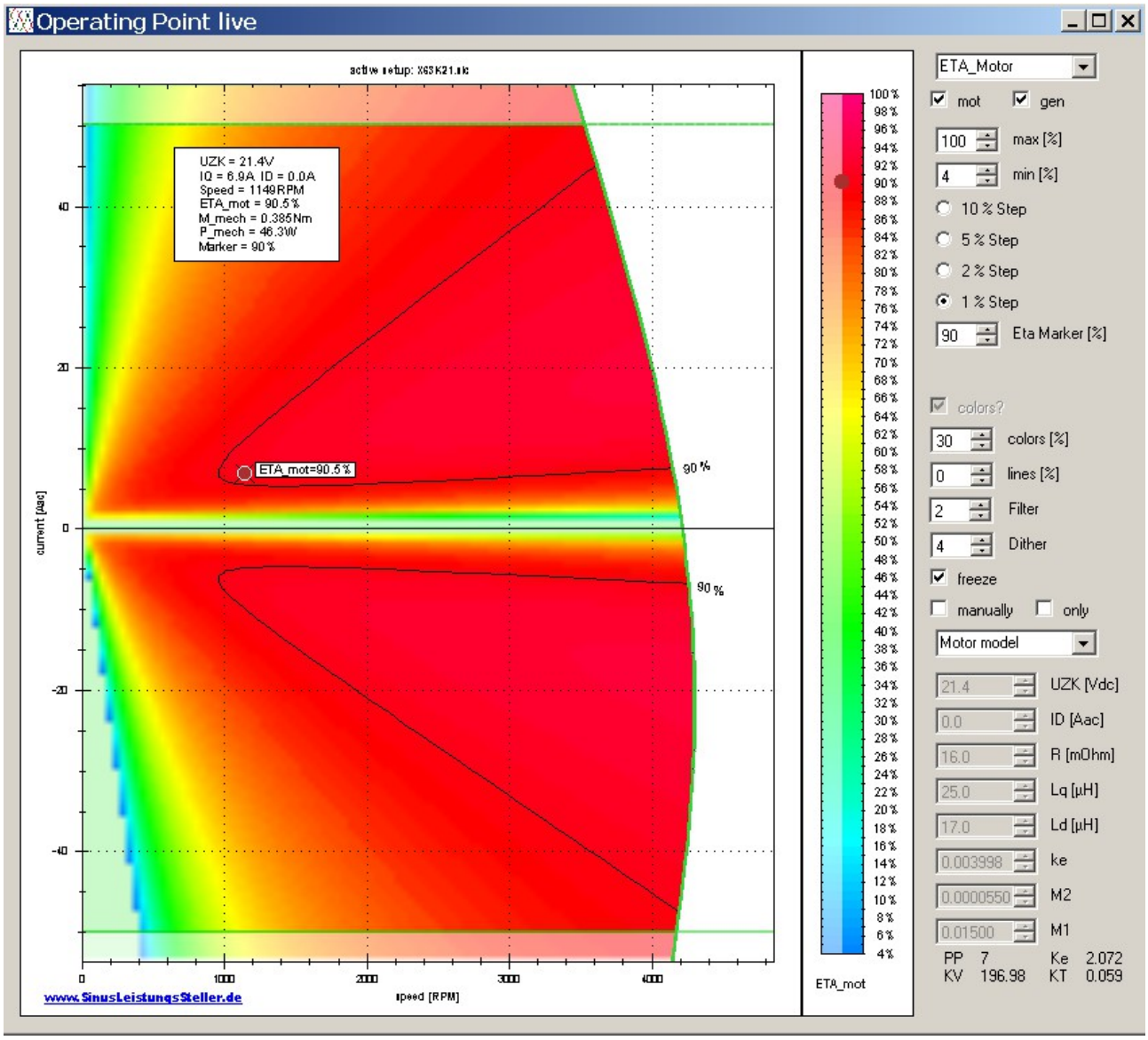
Option ETA_Live introduces a numerical section right side to the graphic-display for additional information an control.



Introduced new graphic-elements are organized as "layers". Selection of such layers is done in right upper corner. Layer Standard displays equal graphical information as Option OperationPoint_Live.

For a detailed documentation of all new controls and other numeric information shown, please refer to SLS-Windows-Monitor Manual: **Manual_WMon_en.pdf**

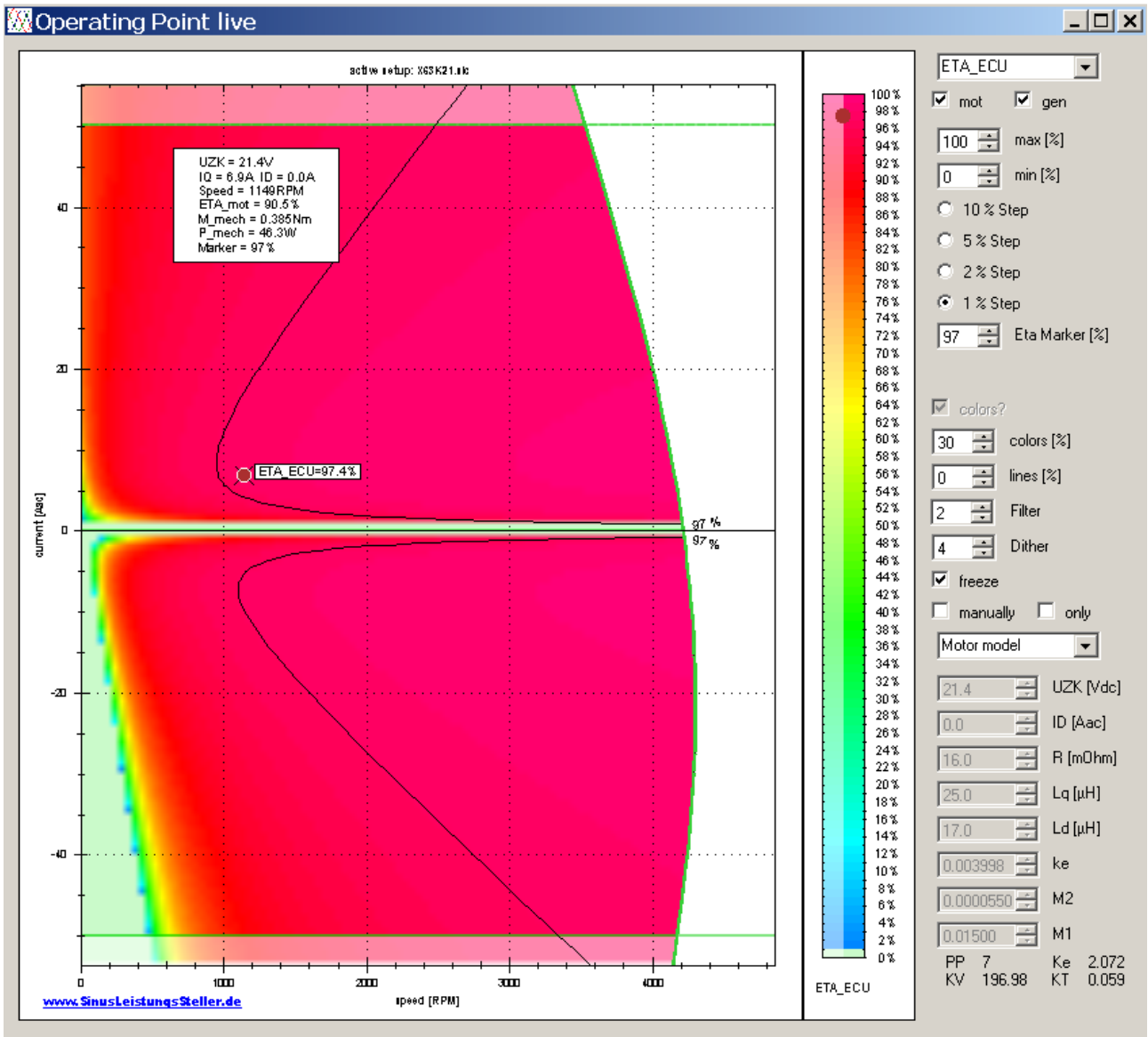
3.2 Layer "ETA_Motor"



Most important layer is ETA_Motor, because at the motor the highest losses of the whole systems occur, and so most gain can be achieved with optimization and right choice.

With manually-mode a direct access to the motor model is possible. Changes in manually-mode will be computed as a separate model - results can be displayed together with the origin motor model to see effects and changes directly. Manually model is display separatly if only is checked.
Manually-model is preset with parameters of the origin model when entered, changes are NOT saved or transferred to the origin-model when leaved. All manually-parameters are temporarily only!

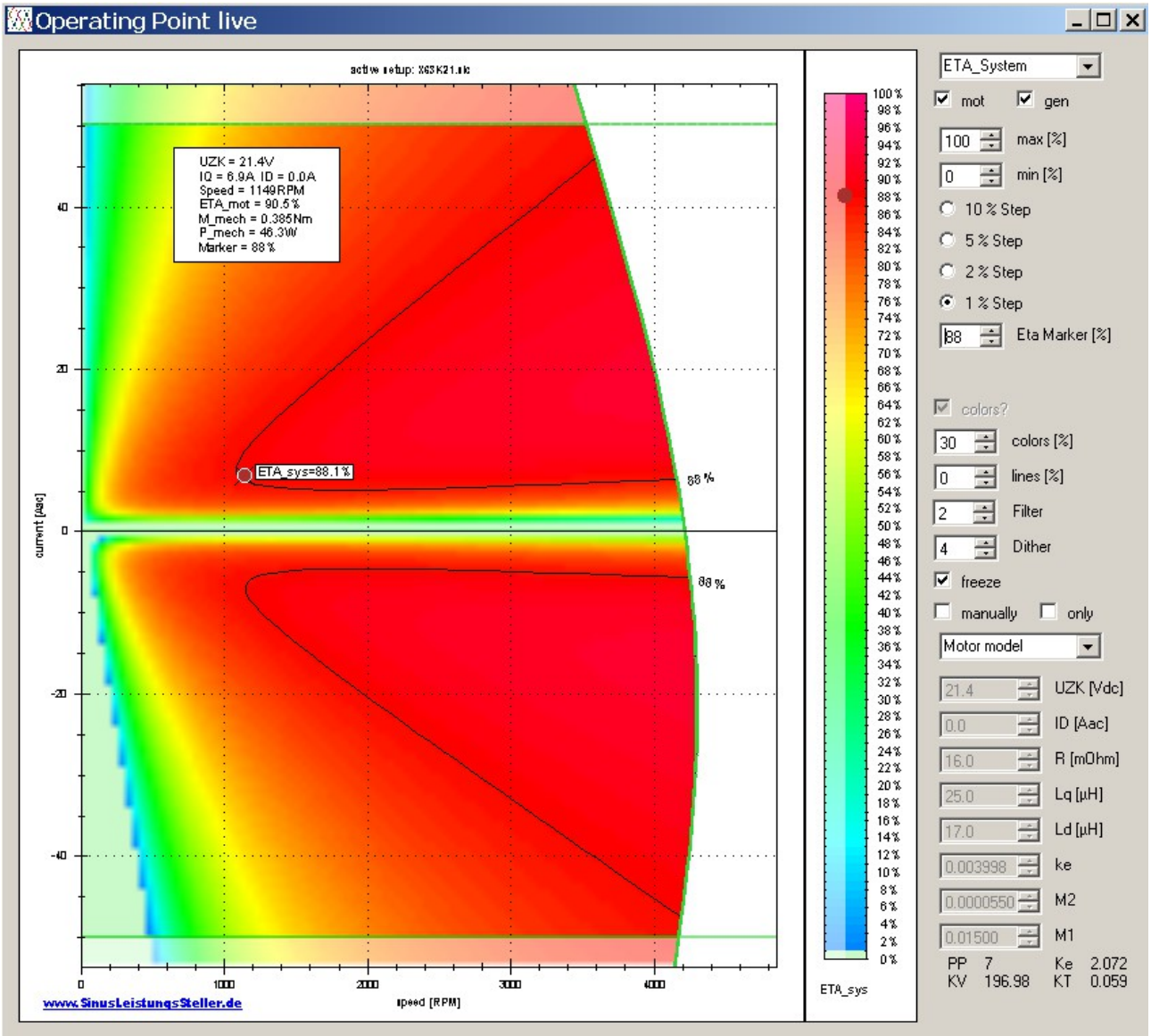
3.3 Layer "ETA_ECU"



Efficiency of the "ElectronicControlUnit" (ECU) - in this case the SLR applied - can be displayed in layer ETA_ECU.

The model of SLR is supplied with it's coefficients from SLR-firmware, considering differences in SLR-hardware-variants (e.g. R_{ds_on} of installed MOSFETs) and run-time changes (e.g. MOSFETs temperature).

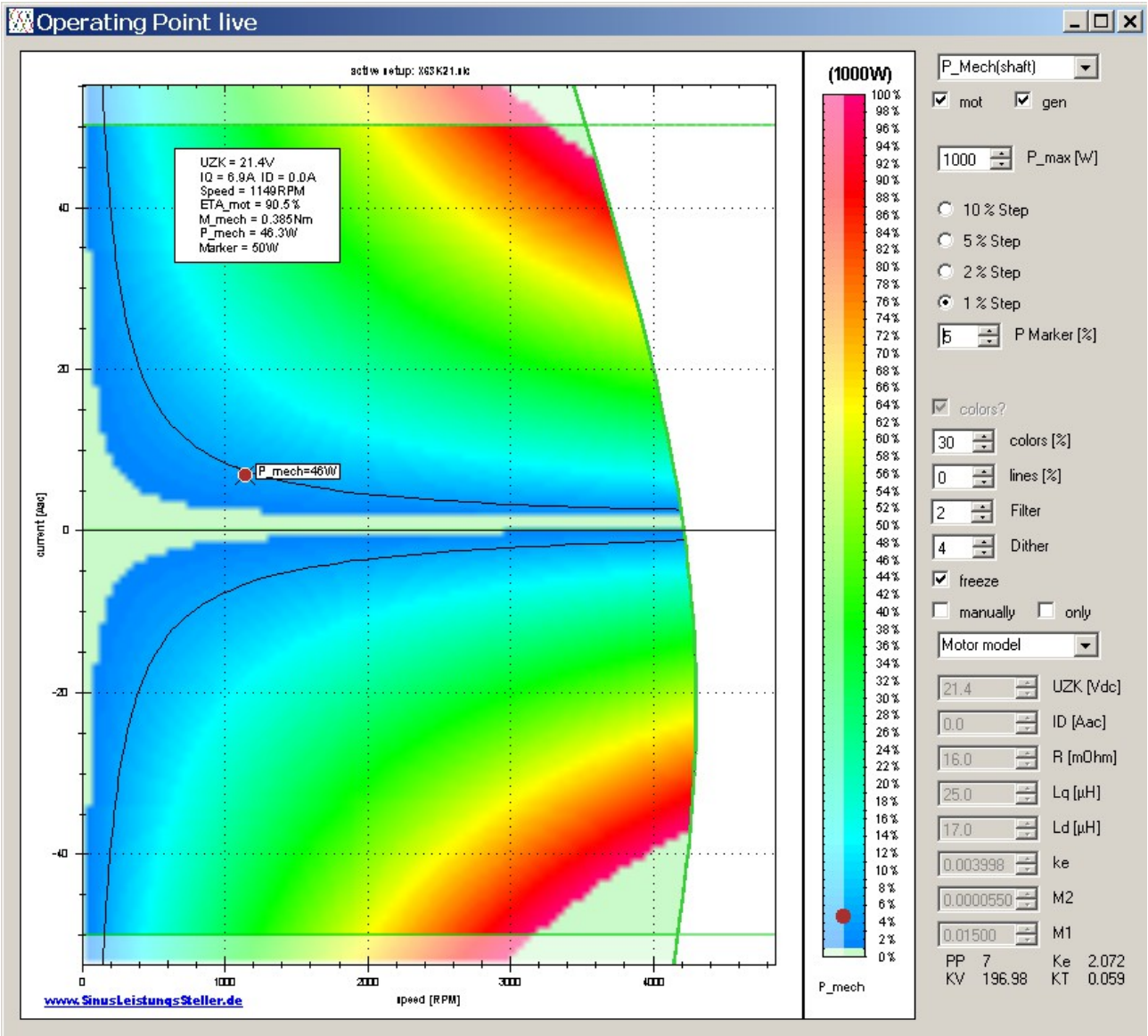
3.4 Layer "ETA_System"



Layer ETA_System = ETA_Motor * ET_ECU for each point in the displayed area.

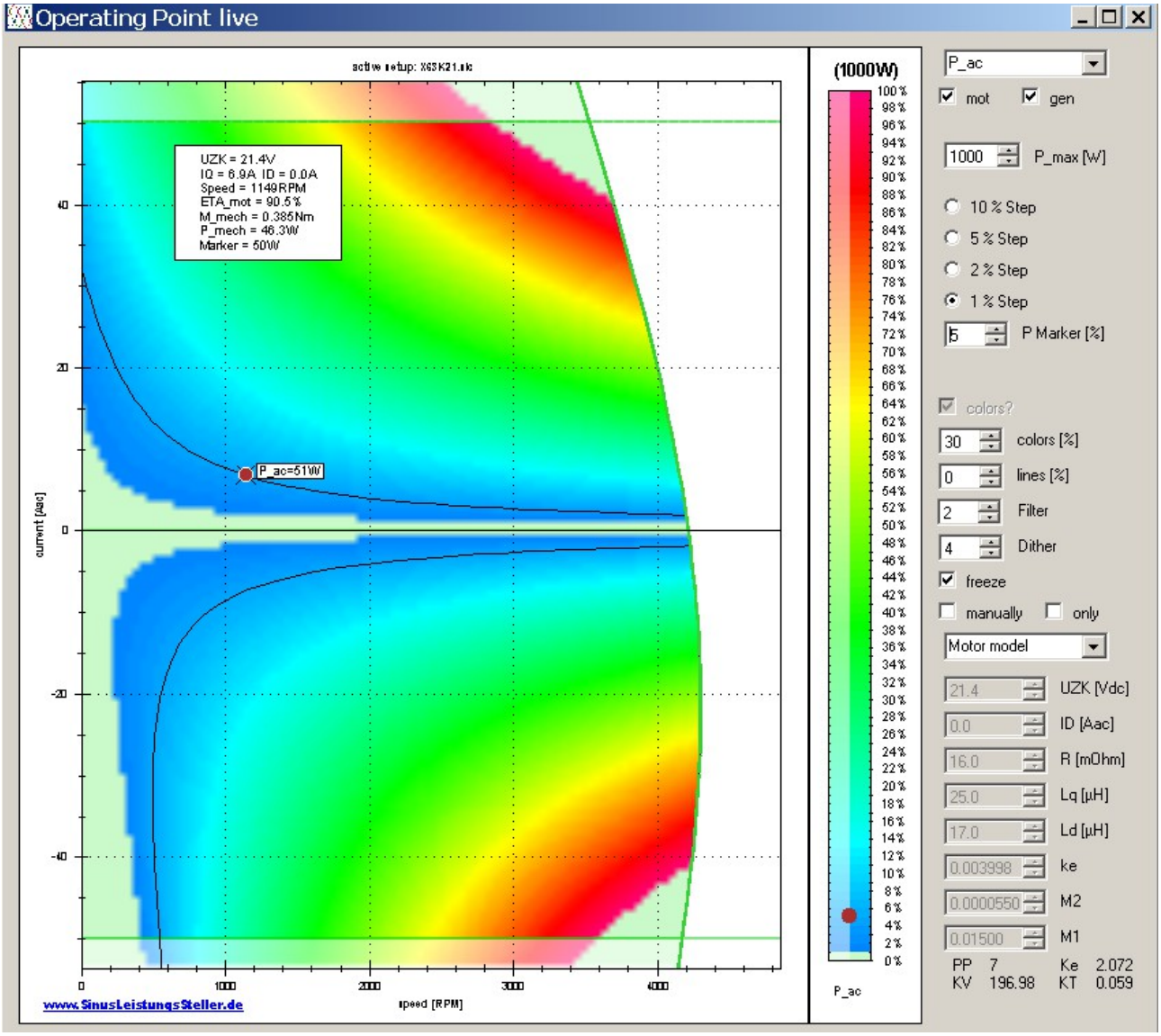
It is the overall-efficiency of the whole drive-system.

3.5 Layer "P_Mech(shaft)"



Mechanical output power on the shaft of the motor is displayed in layer P_Mech(shaft) by P = Torque * Omega for each point of the displayed area.

3.6 Layer "P_ac"

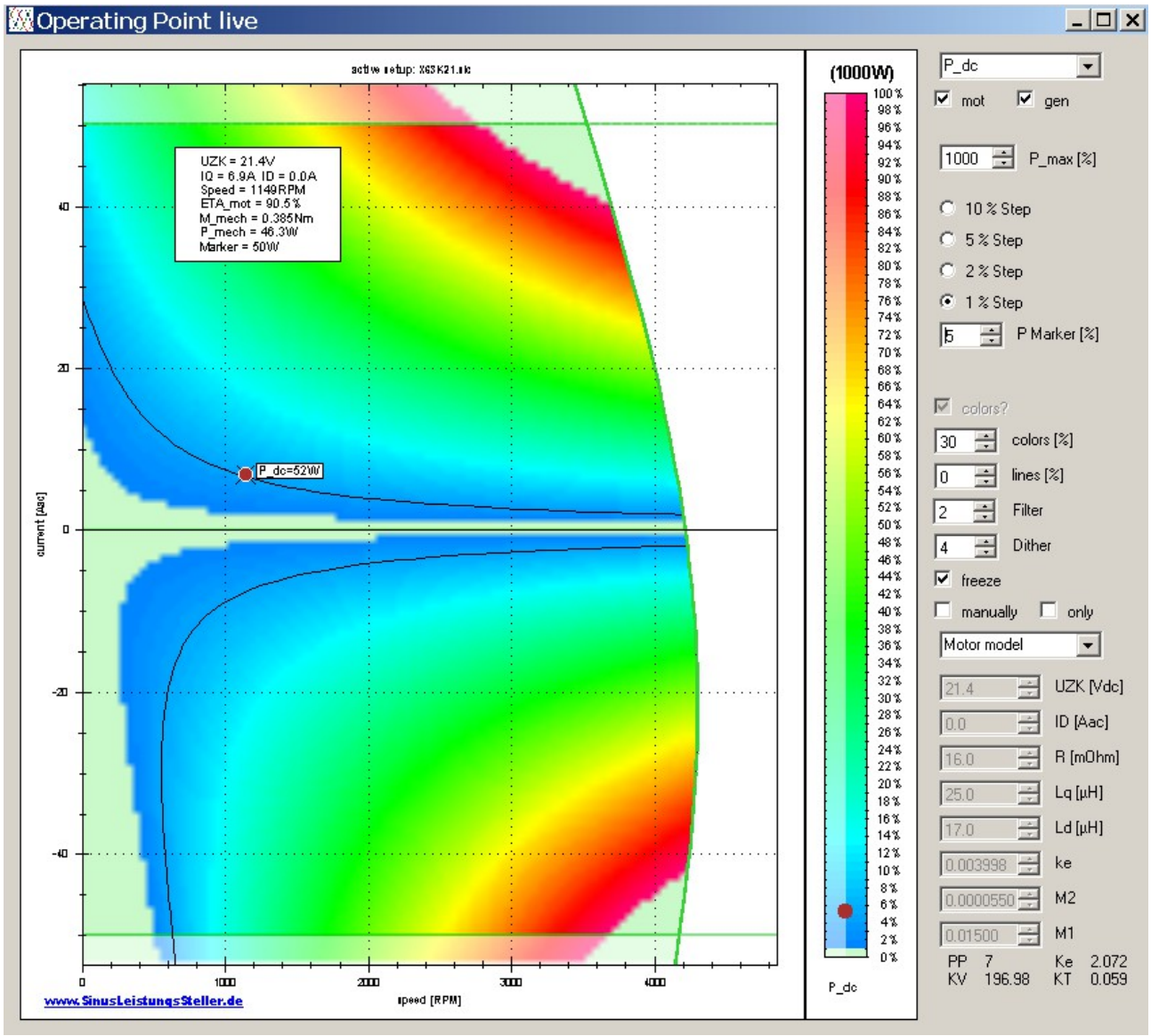


Layer P_ac displays the power level calculated for the AC-lines (the 3 motor phase lines). Its both: ECU´s output-power and motor´s input power.

formula related:

P_Mech(shaft) = P_ac * ETA_Motor

3.7 Layer "P_dc"



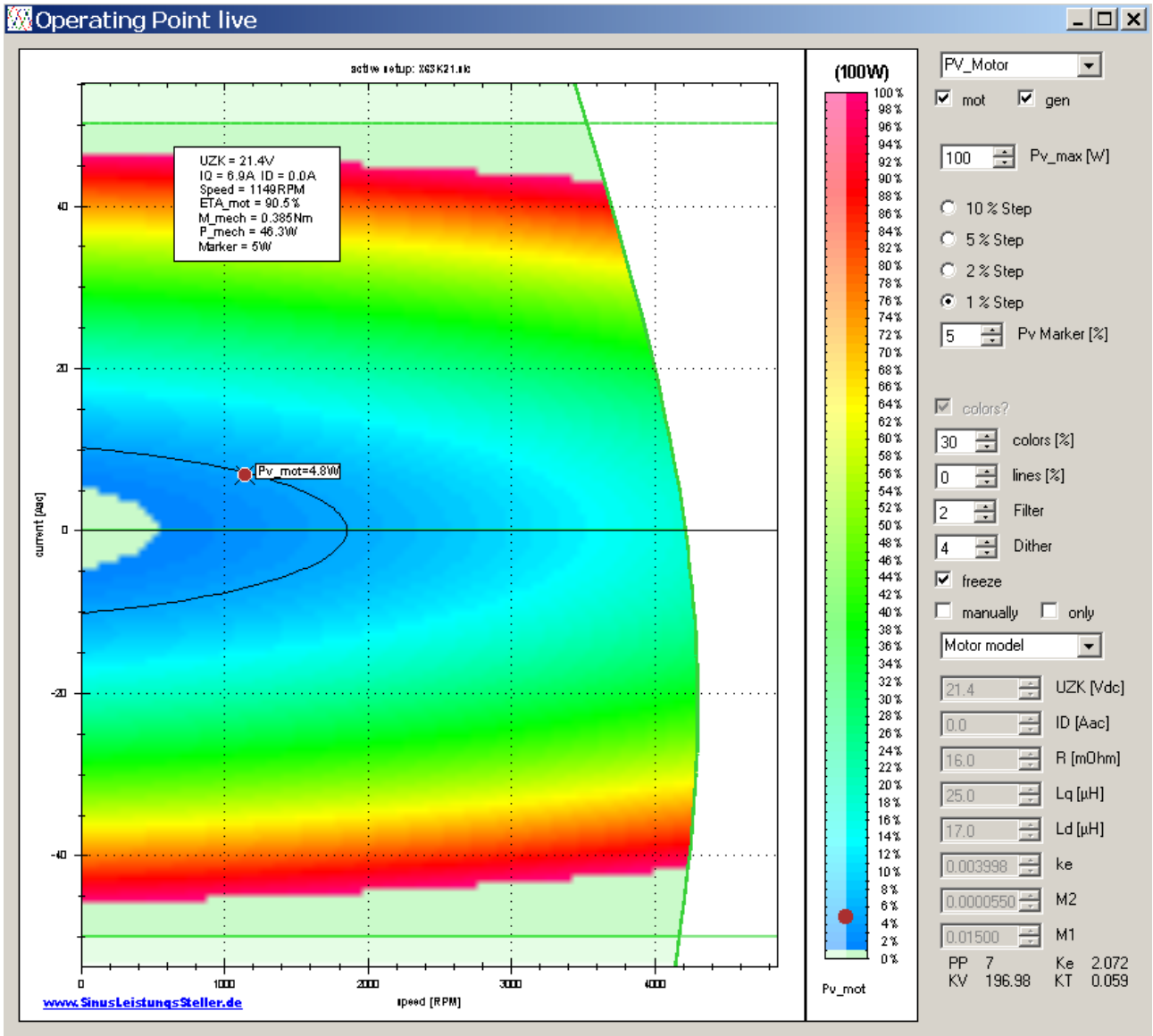
Layer P_dc displays the power level calculated for the DC-lines.
Its both: ECU´s input-power and battery´s output power.

formula related:

P_ac = P_dc * ETA_ECU

P_Mech(shaft) = P_dc * ETA_ECU * ETA_Motor

3.8 Layer "PV_Motor" (motor's losses)



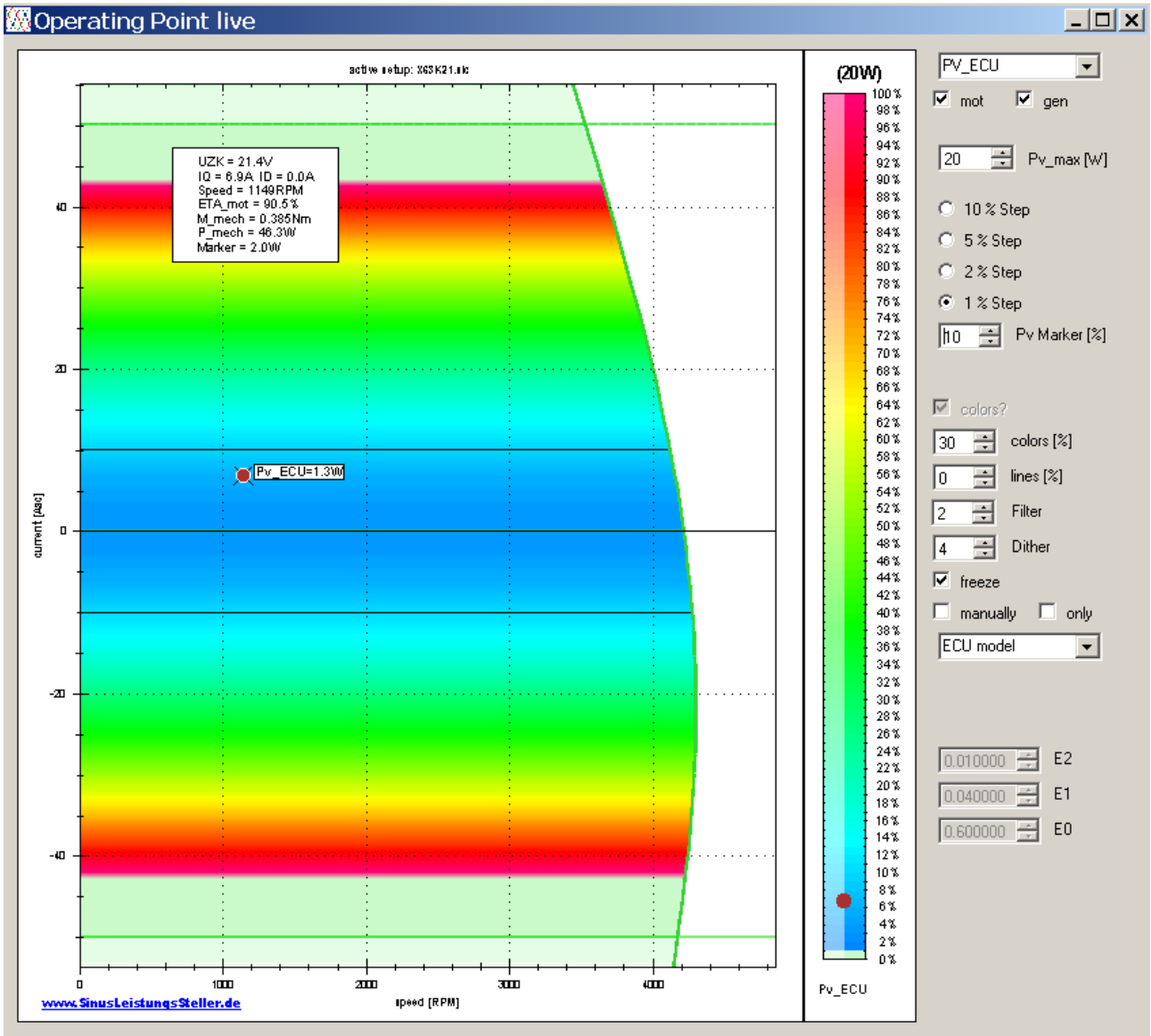
To know motor´s losses at certain working point makes it easier to estimate needed cooling and allowed runtime in overload condition.

Motor´s losses can be split into copper-losses (wiring PV_cu~I²R) and ferro-losses (PV_fe) resulting from eddy-currents and cyclic magnetization reversals.

formula related:

PV_Motor = P_ac - P_Mech(shaft)

3.9 Layer "PV_ECU" (SLR´s losses)



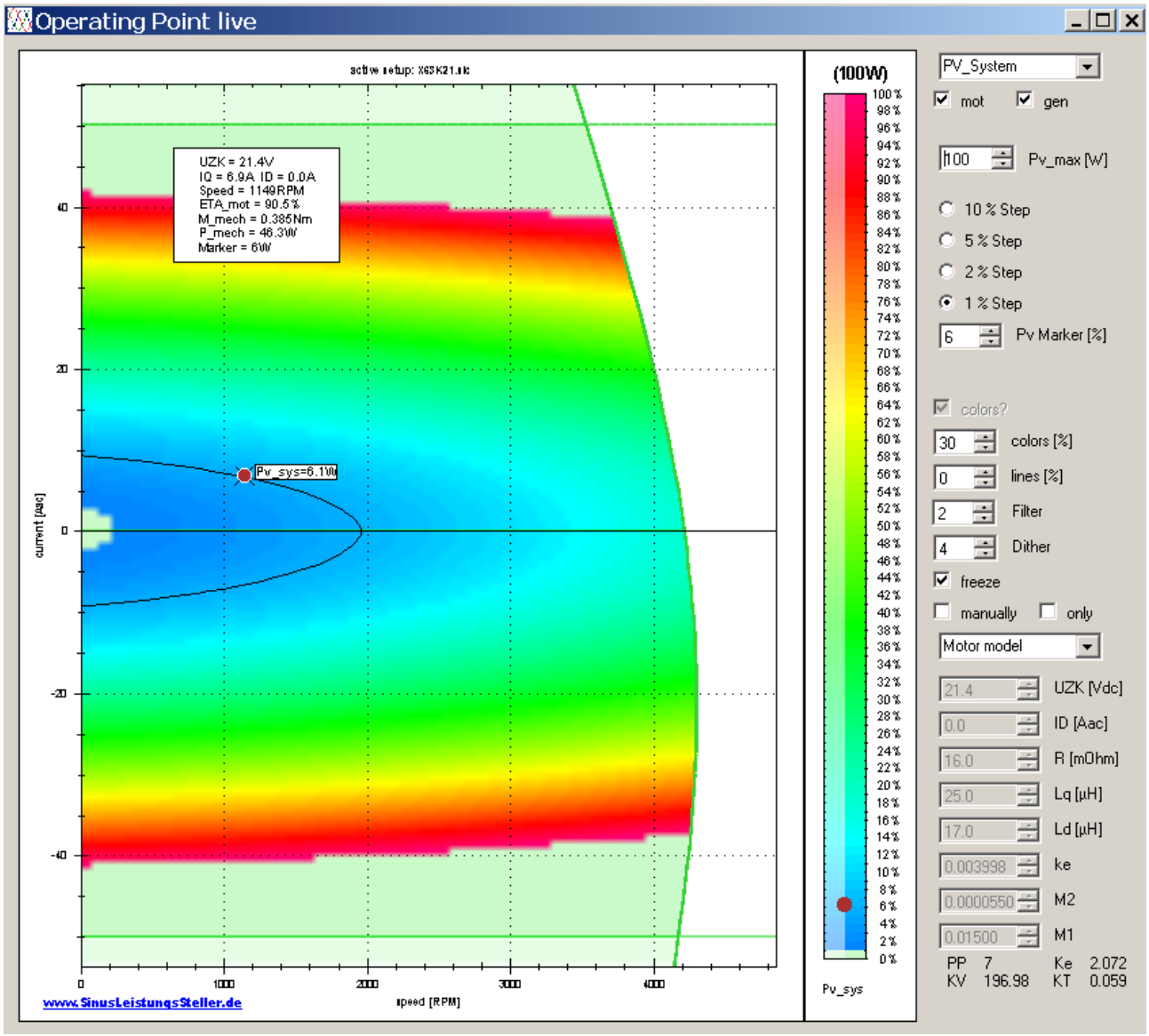
To know ECU´s losses at certain working point makes it easier to estimate needed cooling and allowed runtime in peakload condition.

ECU´s losses are linked with phase-current, R_dson of installed MOSFETs and switching-frequency. ... it´s not correlated with motor speed!

formula related:

PV_ECU = P_dc - P_ac

3.10 Layer "PV_System" (System's total losses)



Layer PV_System adds up PV_Motor and PV_ECU for each point in the displayed area.

formula related:

PV_System = PV_Motor + PV_ECU

4 Control and Processing

4.1 Processing

A powerful zoom function allows to set focus on each area of diagram you like. Finished diagrams with all elements can be saved as picture to be used for later documentation or printout.

4.2 Control

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

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.