

EFFICIENCY MAP MADE EASY



DEWETRON

THE MEASURABLE DIFFERENCE.

- > Precise visualization of efficiency directly in OXYGEN
- > Easy configuration with a few clicks
- > Online efficiency visualization
- > Correction of wrong measurement points
- > Efficiency for each measured point in a color-coded map
- > Different operation modes: testbed-controlled, semi-automatic, manual use

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When focusing on drivetrain testing, the efficiency analysis of the powertrain components plays a crucial role and is highly important for the overall efficiency analysis of the drivetrain.

An efficiency map is a convenient solution to precisely visualize the efficiency of the drivetrain directly in OXYGEN, DEWETRON's measurement and analysis software. It displays the relation between speed and torque for the X and Y-axis and the mechanical efficiency as the input channel for the Z-axis. The efficiency is displayed in a color-coded map with several areas for different values.

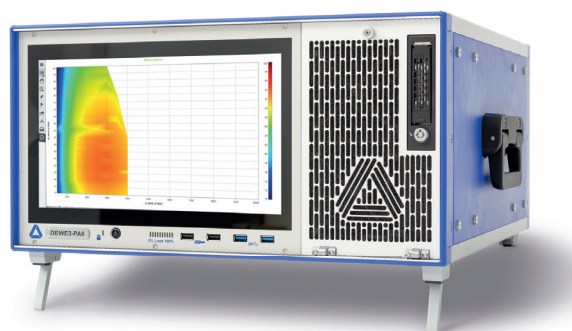


Figure 1: DEWE3-PA8 with Efficiency Map on its multi-touch display

This map gives a good overview over the whole measurement range and for all load steps for the analysis of the efficiency for any combination of speed and torque compared to single values at different measurement points. Consequently, it can be used to design components in a way to maximize the total efficiency for the regular working areas.

An additional advantage is the possibility to correct wrong measurement points within the same measurement procedure. This can be done by simply overwriting a specific value in the map without losing the rest of the already measured points. Furthermore, different trigger options are available for different operation modes, like testbed-controlled or manual use.

This whitepaper explains the creation of an efficiency map in OXYGEN and the advantages that result from the use of this feature.

INPUT SIGNALS

DEWETRON's mixed signal Power Analyzer is the future-proof solution for any power application. Mixed signal inputs are the basis in order to capture not only voltage and current signals but also all relevant mechanical and environmental parameters to gain a complete picture of your DUT.

Time synchronous measurement of mechanical efficiency along with power values is a crucial factor in order to get significant results. All power values are calculated for each period for a correct calculation of all further parameters. For the mechanical efficiency, speed and torque signals are necessary alongside with the voltage and current signals for a power measurement.

With these parameters the basis for an Efficiency Map is created.

CREATION OF A POWER GROUP

For the calculation of the power parameters a so-called Power Group can be created in OXYGEN. Select the voltage and the current channel for each phase individually in this order and click on the *lightbulb* button in the lower left corner.

The Power Group will appear as a new section in the channel list. When expanding this section, all calculated parameters can be seen. These include for example for the voltage the total RMS (with harmonic frequencies) value for each phase and all phases combined, the fundamental RMS (only fundamental frequency) value for each phase and all phases combined, average and peak-to-peak value for each phase. Additionally, many parameters for current, active, reactive and apparent power are included together with power factor and energy values.

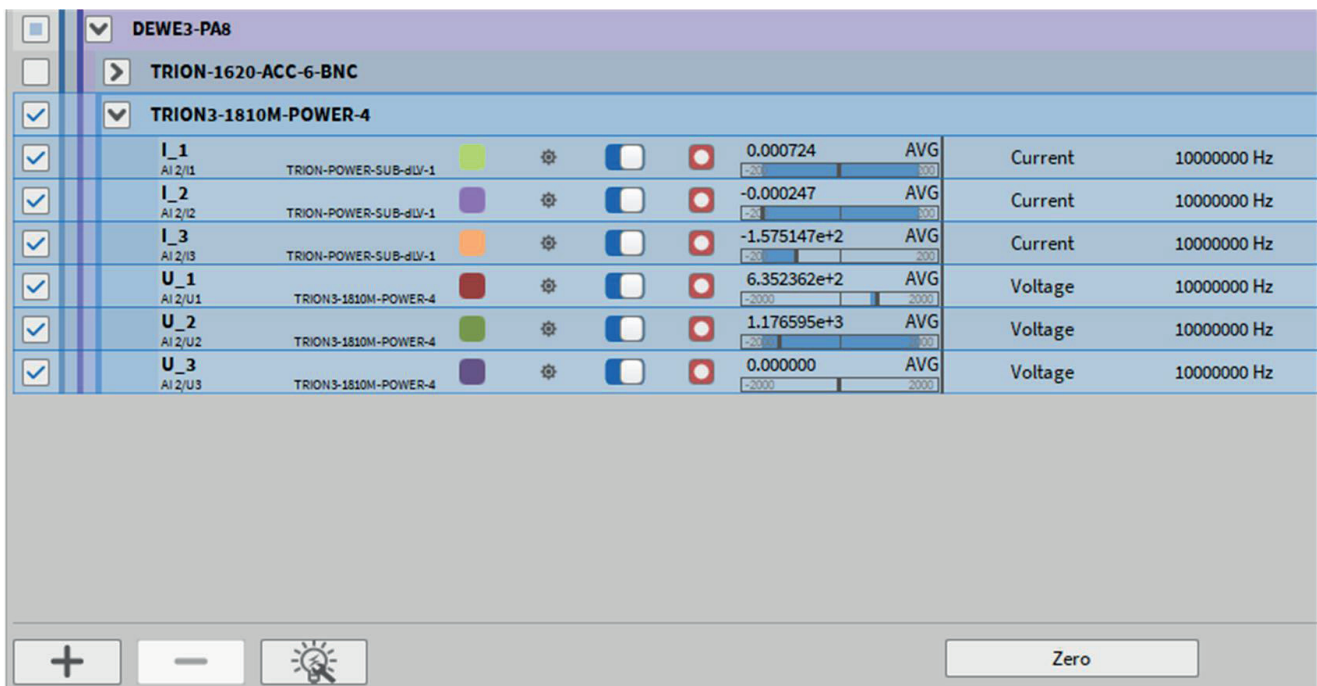


Figure 2: Creation of a Power Group in OXYGEN



Figure 3: Power Group in the channel list with the calculated parameters

With these simple steps a power measurement can be performed. The mechanical power analysis can be enabled in the Power Group settings (*Advanced Settings > Mechanical*), which can be opened by clicking on the small *gear* button in the Power Group channel (see *Figure 2*). There, the speed (unit must be [rpm] or [U/min]) and torque (unit must be [Nm]) can be assigned to a mechanical power analysis. The advantage is that the electrical power and mechanical channels are synchronous to each other – without any more effort. The time period for the calculation of the mechanical power analysis is the same as for the electrical power values, and will, therefore, be updated for each period.

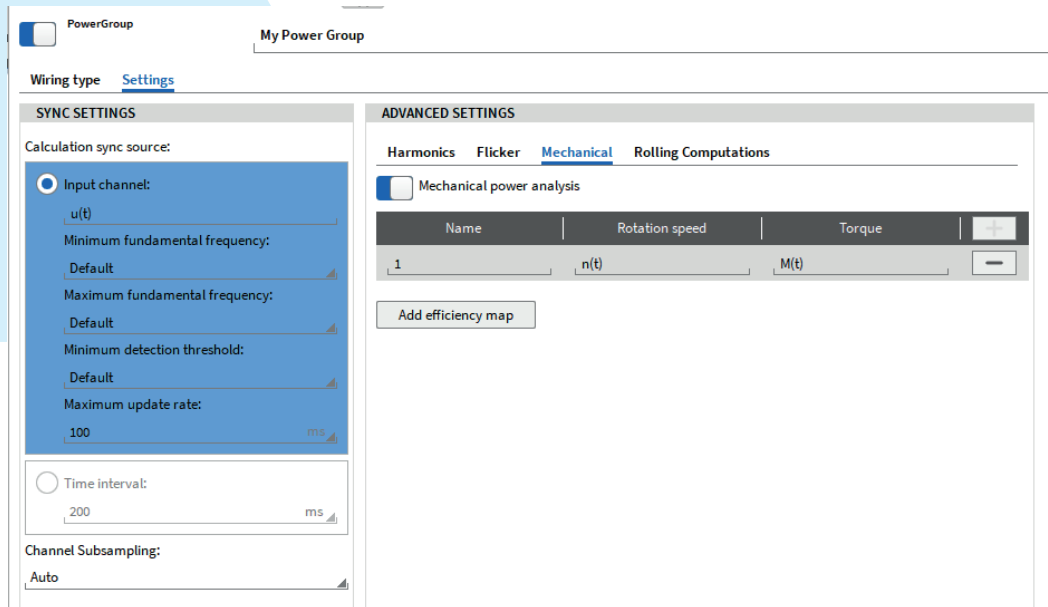


Figure 4: Mechanical power analysis setting

CREATION OF AN EFFICIENCY MAP

After those steps the Efficiency Map can be created with just one click in the mechanical power settings by clicking on the *Add efficiency map* button. Just like for the Power Group a new section in the channel list appears which is called Matrix Sampler Channel. The reason for the name is that not only speed, torque and mechanical efficiency can be used as input channels, but also other channels can be used in this feature to visualize the dependency of one arbitrary input signal to two freely definable reference channels.

However, if the Efficiency Map is directly created out of the Power Group the following channels are automatically used as input channels:

- > Speed for the X-axis
- > Torque for the Y-axis
- > Mechanical efficiency for the Z-axis

This new data channel includes a variety of different settings, like a customizable averaging window for the input channel Z. The settings also include a preview of the resulting map with the minimum and maximum values and the step size.

Another advantage are the different operation modes, which can be used. The feature can be used in a testbed-controlled environment by defining a trigger channel, therefore, the map will be updated each time the trigger is activated. This trigger can for example be a digital signal provided by the testbed. Otherwise, the steady-state trigger can be used for a semi-automatic operation. No trigger channel must be selected for a steady-state operation. Two conditions can be defined for input channel X and Y in order to arm the trigger. These two conditions are a threshold and time - a threshold the channels must stay within a certain time to activate the trigger and, therefore, put a value into the map.

The other option is the manual operation. This is very useful if a measurement was performed and a specific measurement point must be repeated because of any circumstances. For this manual operation the trigger must be disarmed to suppress the updating of the map and no values are stored in the matrix. Afterwards, the specific measurement point can be approached, and a sample can manually be put into the matrix by clicking on the *Take Sample* button. Wrong measurement values can be corrected like this in a very easy way.

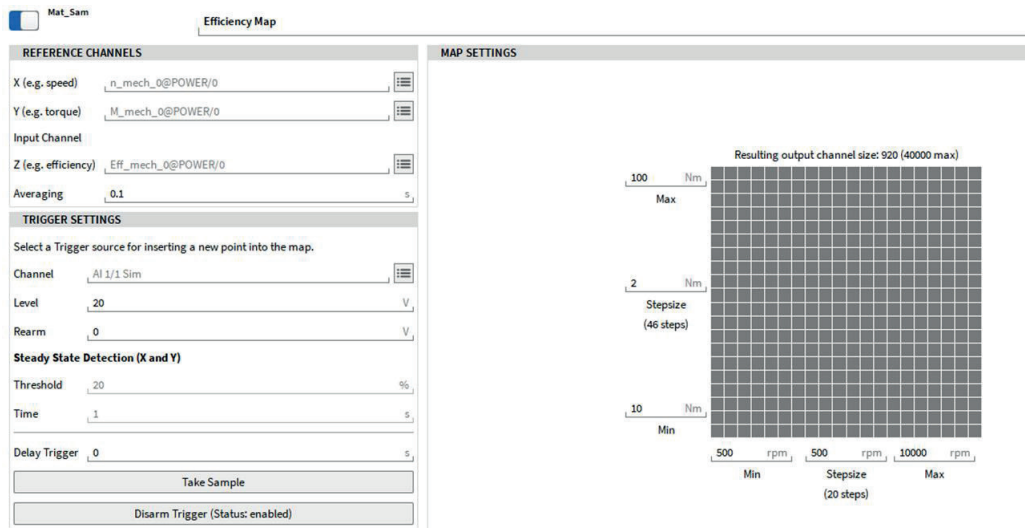


Figure 5: Efficiency map (Matrix Sampler) settings

VISUALIZATION

The Efficiency Map can simply be visualized with the Intensity Diagram in OXYGEN, by dragging and dropping the Matrix Sampler channel onto the measurement screen. The map will fill up during the measurement, giving a direct impression of the efficiency. A linear interpolation can be chosen, just like different level grading options. The following figures show how the map fills up during a measurement, which allows direct conclusions or an overview of the efficiency over the whole measurement range.

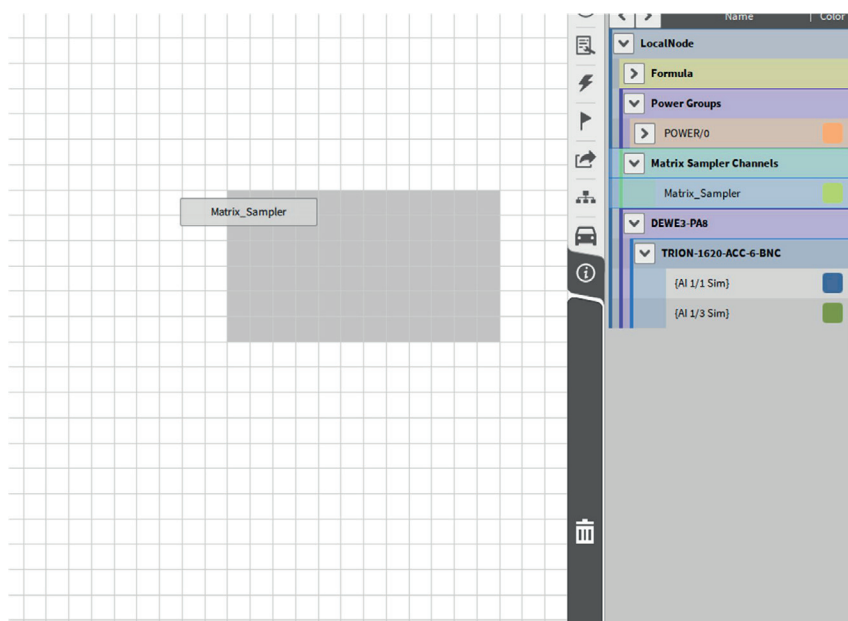


Figure 6: Drag'n'drop Matrix Sampler onto the measurement screen

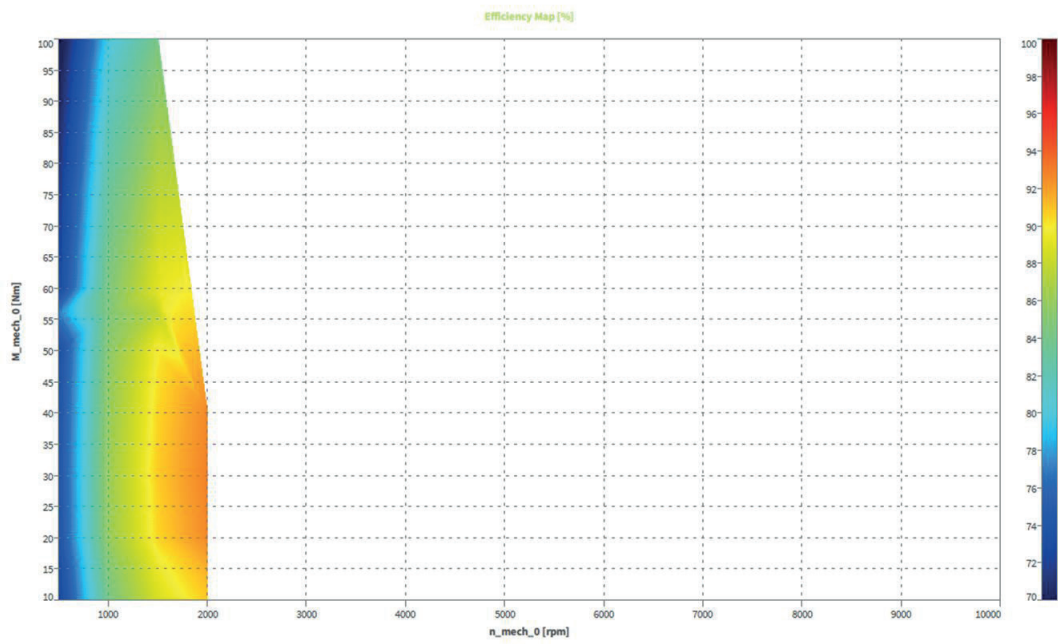


Figure 7: Efficiency map beginning to fill up during a measurement at 2000 rpm

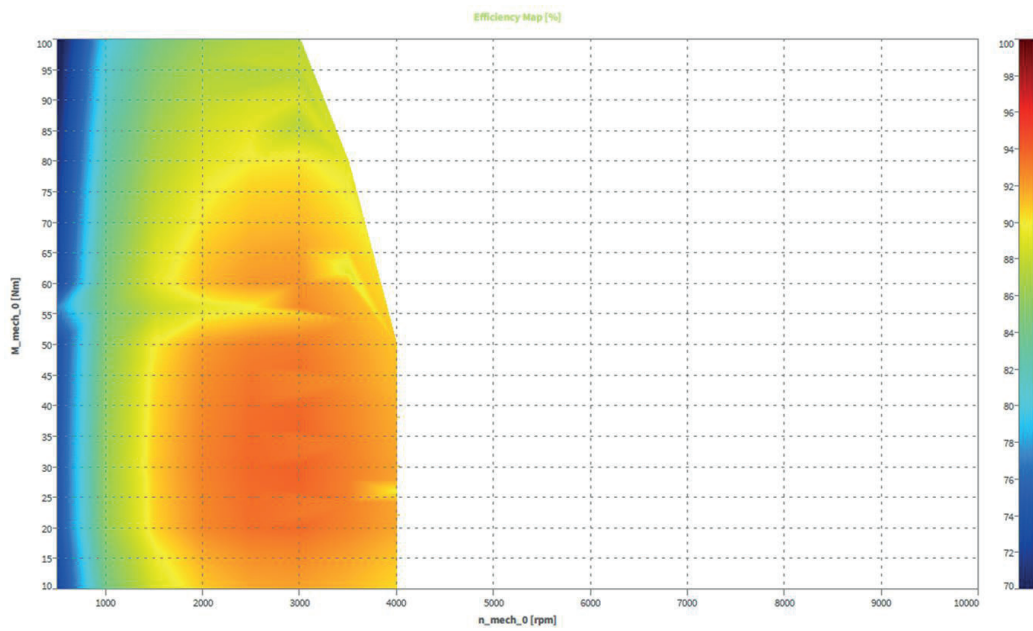


Figure 8: Efficiency map filling up during a measurement at 4000 rpm

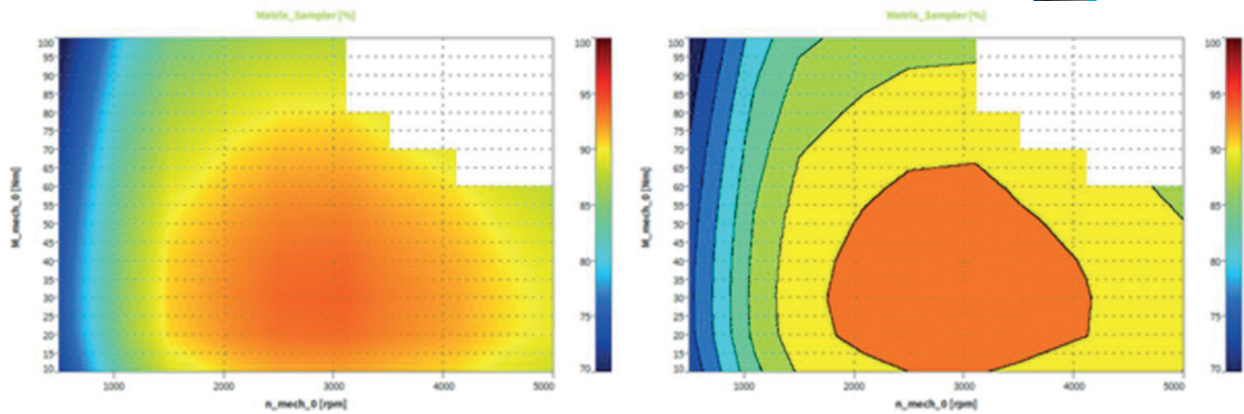


Figure 9: Efficiency map without and with 10-level-gradient

SUMMARY

The Efficiency Map precisely displays the mechanical efficiency in relation to the speed and torque in a color-coded map, which facilitates the analysis and describes the efficiency over a defined range of operating points of the drivetrain.

A fast conclusion can be drawn from the diagram, since it fills up online during a measurement. Multiple trigger options allow the use of different operation modes, which makes this a perfect feature for multiple application measurements.

THE EXPERT

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Verena Niederkofler pursued a degree in biomedical engineering at the University of Technology in Graz with a major in biomedical instrumentation.

During university, she started working as an opto application engineer in the R&D department of an Austrian-based company that designs and manufactures sensors for small form factor, low power, high sensitivity and multi-sensor application. After her graduation, Verena Niederkofler joined DEWETRON as an application engineer for power and general test and measurement solutions.

FURTHER QUESTIONS? **CONTACT THE AUTHOR:**
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